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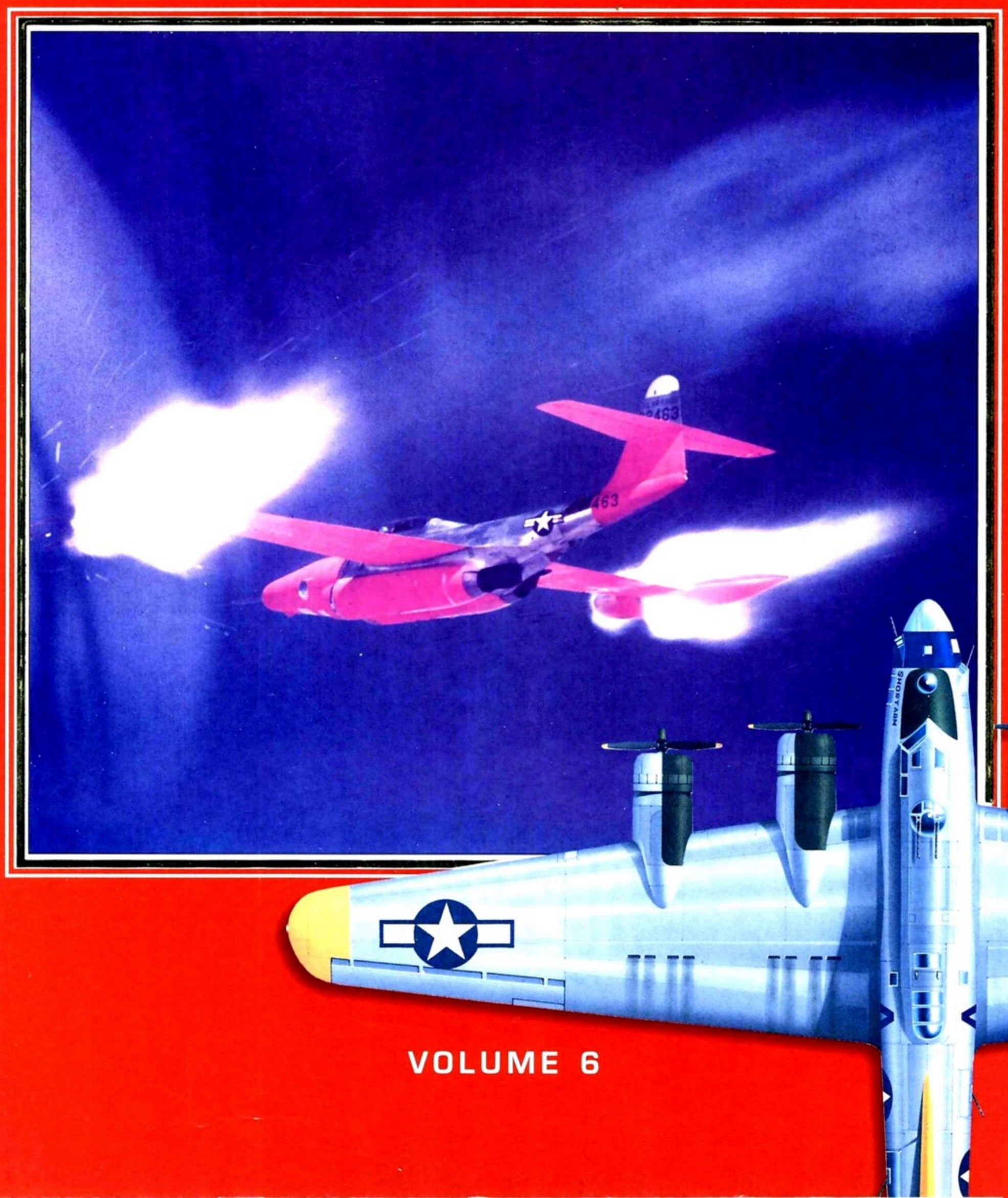

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CONTENTS

Volume 6

Mirage and Dagger in the Falklands

A diary of the air defence and anti-shipping missions of the Dassault deltas during the 1982 Falklands conflict **4**

Salvador Mafé Huertas

Sweden's Ingenious Fighter

A history of the development and operational career of the Swedish fork-tailed fighter, the Saab J 21 **28**

Robert Hewson

Boeing B-17 Flying Fortress

Alongside the Mustang fighter, the B-17 was the most famous American warplane of World War II. This feature describes the development, wartime service and post-war career of a true classic **38**

William N. Hess, operators by Jim Winchester

Air Commandos

Among the first US servicemen to see action in Vietnam were the Air Commandos, flying a collection of prop-driven veterans. Here their early story is told **104**

Phillip D. Chinnery

No. 617 Squadron

Made famous as the 'Dambusters', No. 617 Sqn also undertook other specialist bombing tasks. These are described here, along with the post-war history **118**

Francis K. Mason

Northrop F-89 Scorpion Variant Briefing

A stalwart of the Cold War, the F-89 Scorpion was kept in the forefront of the US air defence network for many years thanks to continuing development of its armament. This variant-by-variant analysis has full details **128**

Robert F. Dorr

Welkin and Type 432

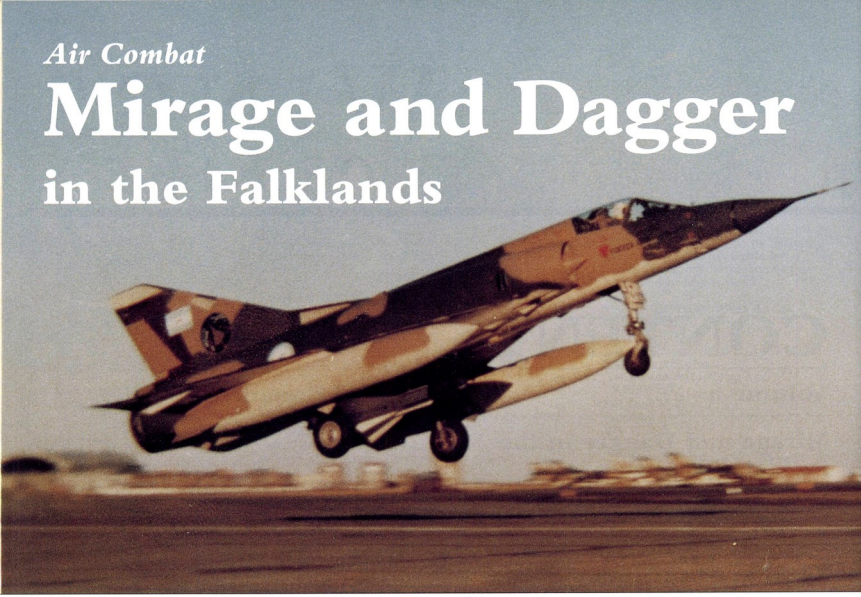
The saga of Britain's ill-fated high-altitude fighter programme is recounted **148**

Bill Gunston

Index **158**

Air Combat

Mirage and Dagger in the Falklands



The Dassault Mirage III and IAI Dagger were potentially the most capable aircraft fielded by the Fuerza Aérea Argentina during the Falklands War, yet neither proved any match for the well-flown Sea Harriers. Nevertheless, the Mirages provided necessary air defence for the mainland, while the Dagger scored a few expensive yet notable successes against Royal Navy warships.

March-April 1982

Dagger force on the eve of war

On 31 March 1982, Grupo 6 de Caza was under the command of Comodoro (Colonel) Thomas Rodriguez. Its two flying squadrons were commanded by Majors Juan Sapolski and Carlos Napoleon 'Napo' Martinez, both of whom had made the Dagger conversion in Israel four years earlier.

For most of Grupo 6's members, the Argentine occupation of the Falklands Islands on 2 April 1982 came as a big surprise; pleasant for some, worrying for the majority. First Lieutenant Cesar Roman, a Dagger pilot, explains his feelings at the time: "As a flight commander I was given notice by my superiors of the Argentine landing close to Stanley a few hours before it took place. I was made very nervous and tense by these events. As a member of a fighter outfit I had a great desire to participate in the hostilities, as that would be our baptism of fire, putting to good use all the daily training."

On 2 April 1982, Grupo 6 had a strength of 37 aircraft (one single- and one two-seater had been lost in separate accidents), of which about 60 to 70 per cent were serviceable. Most of the pilots had little experience on the type due to the unit's recent activation, but there was a small cadre which was very experienced in fast jet operations (Skyhawk, Sabre and Mirage III). The group's readiness level was lower than desired in employing the Dagger as a weapons system, as one of its pilots, Jose Luis Gabari Zoco, elaborated. "I had just been posted to Grupo 6 de Caza; before, I was flying the A-4C at Mendoza. During early April I was instructed in the theoretical stage prior to flying the Dagger and I made my first flight on 20 April, together with other newcomers like Captain Demierre and First Lieutenant Antonietti. Until 1 June, I flew as much as possible, flying replacement aircraft to San Julian and Rio Grande."

Argentine pilots pose before the war in front of their Dagger A fighter-bombers. The unit was at low readiness when the conflict erupted, with many pilots having only recently converted to the type.

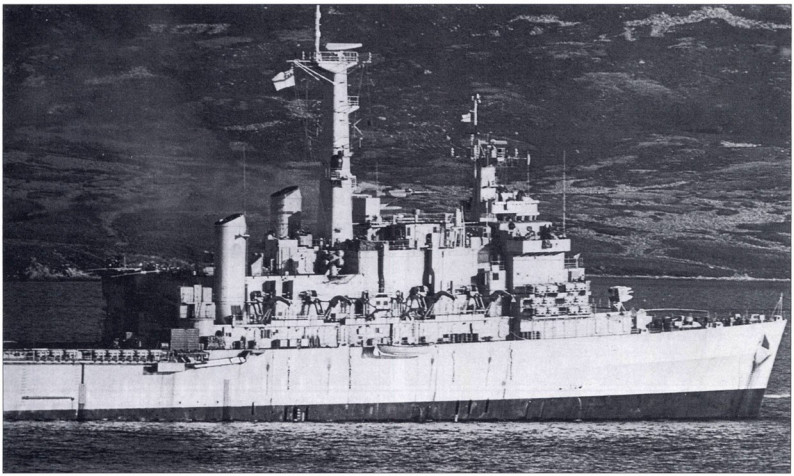
Cesar Roman had this to say: "During most of April I underwent intensive training at Comodoro Rivadavia in anti-shipping operations against target ships provided by our navy. One thing was clear: attacking a moving object such as a vessel was much more difficult than I had thought."

From the first day, Grupo 6 commenced an intensive training

A Mirage IIIEA of Grupo 8 de Caza launches from Rio Gallegos for a CAP mission during the war. It carries a single MATRA R.530E semi-active radar-guided missile as its primary armament. This weapon was found to be almost useless in combat with the Sidewinder-equipped Sea Harrier, and it was believed only one was fired, and that did not have a satisfactory lock-on prior to launch.

Right: Photographed a few months before the war flared up, this Mirage IIIEA is flying from its peacetime base at Mariano Moreno. From there the Mirages defended the Argentine capital, Buenos Aires.

Below: A Dagger can be seen between the masts of HMS Fearless during an attack on San Carlos Water, illustrating the typical height at which such raids were undertaken. This was on 24 May, and all four Daggers of AZUL flight managed to escape with only light damage, despite the intense barrage of fire put up by the British defences.



schedule in maritime strike and air combat. On 25 April, part of the unit's complement was deployed to southern Argentine airfields. Thus, two 'mobile squadrons' were activated: number 1 – also known as Escuadrón Dagger Rio Grande – based at Rio Grande naval air station in Tierra del Fuego and commanded by Martinez, with an initial strength of nine Daggers; and number 2 – also known as Escuadrón Dagger San Julian – based at the civilian airfield of San Julian in the province of Santa Cruz, Patagonia, and commanded by Sapolski with 10 Daggers on strength. Both squadrons were declared operational the same day.

In the air-to-air arena, the Dagger's main mission would be that of providing fighter cover to Argentine strike aircraft, plus air superiority. Cesar Roman provides some details of the deployment: "The distance from Tandil to San Julian was covered in one hour and 30 minutes at a cruise speed of 500 kt and at 35,000 ft. During the last week of April the tension among us reached a high level as the British Task Force continued due south, and we were sure that the confrontation was unavoidable. In fact at 19.30 on 29 April, the radar detected some 'blips' far into the ocean approaching San Julian (probably caused by British countermeasures), and the order was given for Daggers to redeploy to Comodoro Rivadavia. The first aircraft were launched 30 minutes later and in 10 minutes all were in the air, including an A-4C squadron. The alarm proved to be false and by mid-morning on the next day we returned to San Julian."

Below: Some Daggers stayed at Tandil during the early part of the war to continue training. This aircraft was photographed there in May, but by early June was flying from Rio Grande.

Mirage III interceptors

During the late 1960s, the FAA staff was aware of the inadequacy of the country's air defence, which rested on the then-obsolete F-86F Sabre and the still older Gloster Meteor. A study group was formed and, after several evaluations, the F-4E was selected as the new fighter/interceptor, but the US Department of State vetoed the sale and the FAA had no alternative but to acquire the second-choice aircraft on their list, the Mirage IIIE.

It was initially intended to licence-build about 100 examples, a number later reduced to 50. After some delay, mainly due to Argentine economic difficulties, a contract was signed with Dassault for the acquisition of 10 Mirage IIIEA interceptors (I-003 to I-012), a simplified variant of the E without the Doppler radar and other systems but with the addition of equipment specified by the FAA. Two dual-seat trainers were also acquired as Mirage IIIDAs (I-001/I-002). A group of experienced Argentine pilots was sent to Dijon, France for conversion to the delta fighter with ECT 2/2, and after their return they acted as instructors.

Deliveries of aircraft started in September 1972, transported to Argentina in the cargo bays of FAA C-130 Hercules. In July 1973 the first flights were undertaken and in that month the I Escuadrón de Caza Interceptora (First Fighter-Interceptor Squadron) was activated, based at Mariano Moreno air base 25 km (15 miles) south of the city of Buenos Aires. To give the unit a more formal structure and to follow the typical designation system used by the FAA, on 9 December 1975 the VIII Brigada Aérea was activated and soon after the Grupo 8 de Caza.

The Mirage IIIEA's main role was the air defence of the republic's capital. From the delivery of the first aircraft until the Falklands conflict in April 1982, two Mirages were lost: I-009 in 1976 on a flat spin from which pilot First Lieutenant Garcia ejected safely; I-001 in March 1979, also on an unrecoverable flat spin from which both pilots, Captain Huck and Colonel Viola, ejected. To augment the fleet and cover attrition, seven new Mirage IIIEAs were acquired in 1979 (I-013 to I-019), with deliveries completed in 1980. They were incorporated into Grupo 8's second squadron. In their primary role of interceptors – their secondary tasking was that of fighter-bombers – the aircraft's armament include two 30-mm DEFA cannon and MATRA R.530 medium-range air-to-air missiles, both in the IR-guided and semi-active radar guided variants. In 1980 a batch of MATRA R.550 Magic short-range IR-guided AAMs was acquired, arriving at Grupo 8 early in 1982.

During the Falklands War the unit lost two Mirage IIIEAs (see later). In December 1982 two new dual-seaters (I-020/I021) were received from France, complementing

I-003 was the first Mirage IIIEA delivered to the FAA, arriving in Argentina in disassembled form in September 1972.

the Mirage flight simulator for familiarising new pilots with the type. On 17 March 1988, the two Mirage squadrons were officially transferred to Grupo 6 de Caza as Escuadrón III and Escuadrón IV, but later amalgamated as Escuadrón I after Grupo 8 and its air brigade were deactivated.

The Mirages originally were delivered in a scheme similar to the USAF's SEA, but during the late 1980s the whole fleet was painted in air-superiority grey. All maintenance of the airframes, engines and avionics, including damage repair, is performed in Argentina by the Rio Cuarto rework facility. In recent years the Mirages have received a few small upgrades, mainly to improve the capability of their RWR equipment. A decision will be made in the near future whether to have them undergo an extensive upgrade, including fitting a new radar to replace the mediocre Cyrano IIbis, or to acquire ex-USAF Lockheed F-16A/Bs to entirely supplant the Mirage IIIEA/DA fleet towards the end of the 1990s.

Right: Badge of VIII Brigada Aérea

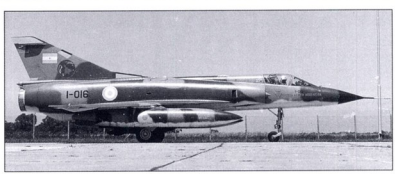
Below left: Still bearing traces of identification markings from the Falklands campaign, this Mirage IIIEA takes off from Mariano Moreno.

Below: Although primarily an interceptor, the Mirage IIIEA has some ground attack capability, as evidenced by this aircraft carrying practice bombs for a training sortie.

April 1982
Mirage mobilisation

On 2 April 1982, Grupo 8 de Caza formed part of Comando Aéreo de Defensa (Air Defence Command). Upon the FAA mobilisation on that day, the unit was put in a high state of readiness which was soon relaxed. As the days passed and the FAA accepted that the situation was not a feint by the British and that the possibility existed of Vulcan attacks, the Mirages were again put on alert, in their main role of interceptors/all-weather fighters rather than fighter-bombers. The maintenance department worked overtime readying the maximum number of operational aircraft, and, of the 16 EAs available, 12 were fully combat capable. The pilots were instructed in the firing parameters of the new (for them) MATRA Magic IR AAM, and were busy studying all available information on the Harrier.

The possibility was studied of basing the Mirage IIIs at Port Stanley airfield, which proved to be impossible since the runway was too short (4,100 ft/1250 m) for safe operations with external loads. After the Fuerza Aérea del Sur (Southern Air Command) was activated to co-ordinate FAA operations in the theatre, Grupo 8 de Caza deployed eight Mirage IIIEAs to Comodoro Rivadavia air base in the province of Santa Cruz. A few days later, four were sent to Rio Gallegos, in the same province but farther south. These eight aircraft comprised the new Escuadrón de Caza Interceptora under the command of Colonel Carlos Corino, Grupo 8 CO. Four remained at Dr Mariano Moreno air base as reserves and for air defence of the capital. For the air defence of the Patagonia and Tierra del Fuego bases and military installations, the FAA had Westinghouse AN/TPS-43E radars at Comodoro Rivadavia, Rio Gallegos and Rio Grande.



This Mirage IIIEA, from the second batch delivered, is seen taxiing at Mariano Moreno for the flight south to Comodoro Rivadavia.

During the war four Mirages remained at BAM Dr Mariano Moreno to defend the capital. This is the officer's mess building.

The biggest handicap for the Mirage III was the more than 400 nm (740 km; 460 miles) that separated Comodoro Rivadavia and Río Gallegos bases from the Falkland Islands. The Daggers with their extra 500-litre (110-Imp gal) tank aft of the cockpit could remain on station for about five minutes. The Mirages would arrive at the islands at great height with no possibility of descending to lower altitude to engage the Sea Harriers, due to fuel considerations. Thus, even before the start of hostilities, the Mirage III had lost the battle for air superiority.

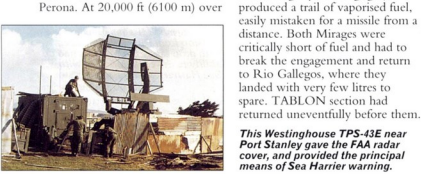
These four Mirages are seen during the long trip south to Comodoro Rivadavia to form half of the Escaudrón de Caza Interceptora. The other half was stationed at Río Gallegos to the south.

On 30 April everything seemed to happen at once: the British were near the islands and the mainland-based Mirages were on instant readiness, while the radars probed continuously in search of hostile contacts.

1 May 1982
Mirage into combat

As a consequence of the 04.45 raid on 1 May by an RAF Vulcan bomber on Port Stanley airfield (known as BAM Malvinas to the Argentines), the FAS issued Fragmentary Order No. 1090 in which two Mirage IIIEAs with the callsign FIERA were launched later that day from Río Gallegos, with Major Sánchez as section leader. The mission's purpose was to provide top cover for Port Stanley airfield in the event of another Vulcan raid. At 07.30, after having been on station for a few minutes, the pair returned to Río Gallegos. This mission and subsequent ones were controlled by the AN/TPS-43E radar located near Port Stanley and by a command post installed in town, known as the CIC.

The sound of two Atar 9Cs in maximum afterburner announced the take-off of TABLON section from Río Gallegos. Two minutes later LIMON section was launched, flown by Captain Garcia-Cuerva and First Lieutenant Perona. At 20,000 ft (6100 m) over the Falklands they were vectored to cut across an A-4B flight and a Sea Harrier CAP which was trying to bounce them; the Royal Navy fighters broke off the engagement. Seconds later, LIMON section received vectors to intercept another Sea Harrier CAP, this one from No. 801 Squadron and flown by Lieutenant Commander Ward and Lieutenant Watson. Garcia-Cuerva and Perona pursued the Sea Harriers until they were 15 miles (25 km) behind them, at which point the Sea Harriers made a quick 180° turn to engage the Mirages head-on. The distance was shortening dramatically, and the British pilots watched as one of the Mirages (which were higher) fired one or more missiles, which, due to the distance, fell short. In fact, only one MATRA R.530 was fired and that by mistake, without a full radar lock-on. The other perceived missile launchings were the 1700-litre (375-Imp gal) drop tanks which, when ejected (to increase agility in a dogfight), produced a trail of vaporised fuel, easily mistaken for a missile from a distance. Both Mirages were critically short of fuel and had to break the engagement and return to Río Gallegos, where they landed with very few litres to spare. TABLON section had returned uneventfully before them.



This Westinghouse TPS-43E near Port Stanley gave the FAA radar cover, and provided the principal means of Sea Harrier warning.

Argentina's Daggers

The first Daggers arrived in Argentina in December 1978 aboard the merchant vessel *Jaspers*, and were unloaded in the port of Buenos Aires. These aircraft were IAI Neshers constructed in Israel in 1974. In accordance with the Dagger contract, 26 aircraft were supplied in a record time of six months, which included a refurbishment. In the Fuerza Aérea Argentina, the aircraft were also known as Mirage M-5 Daggers. During 1980 the Dagger II contract was signed, which encompassed 13 additional examples plus spares, engines and a simulator. This total of 39 machines was broken down as 35 Dagger A (Nesher A) single-seaters, seralled C-401 to C-424 plus C-427 to C-437, and four Dagger B (Nesher T) two-seaters, C-425, 426, 438 and 439.

Badge of Grupo 6 de Caza

Mariano Moreno air base was the home of the first Daggers, until they relocated to Aérea Material Río Cuarto (Air Depot) early in 1979. The type's first public appearance took place at the Escuela de Aviación Militar (Military Air School) in January of that year when Brigadier General Garaffigna took over the job of Chief of Air Staff. Major Sapolski had been the first Argentine pilot to fly solo in a Nesher/Dagger, on 9 November 1978, while performing the conversion in Israel. On 8 August 1979, the first batch of Daggers was delivered to Tandil air base, named after a nearby city. The air base is about 300 km (185 miles) south of the nation's capital, and also in the province of Buenos Aires. During the following days all available aircraft at Río Cuarto were ferried to Tandil. On 3 December, VI Brigada Aérea was commissioned, while the provisional Escuadrón Dagger became Grupo 6 de Caza, under the Air Defence Command (Comando Aéreo de Defensa). Upon the arrival of the second batch, more pilots were posted to the unit, which for operational purposes was divided into two squadrons.

These aircraft had been designed for a completely different theatre of operations than that of the Falkland Islands. After the war, the Fuerza Aérea developed an upgrade programme which included a complete series of modifications: the surviving Dagger A received the avionics of the Kfir C7, including the navigation/attack computer, ranging radar, HUD and ECM. The retrofit was carried out entirely at the Aérea Material Río Cuarto, with the support of several Israeli companies headed by IAI. Once upgraded, the aircraft again changed their name, this time to Finger.

Initially, the Nesher had been a clear weather air superiority fighter, and after modification to Finger standards became an effective attack/interdictor, capable of operating in bad weather. The Finger armament for the air-to-air role comprises the 30-mm DEFA cannon and the Shafrir IV IR-homing AAMs. The aircraft have seven hardpoints for external loads versus five in the Mirage, and maximum warload for short-range missions is 4000 kg (8,820 lb). Both jets, the Mirage and Dagger/Finger, are powered by the same Atar 9C engine, the first built in France and the second in Israel. There are small differences in the engine controls, but the powerplants are completely interchangeable.

The first Daggers were originally painted in a camouflage scheme similar to that of the Mirages. Later, like their brothers, they lost the national markings and serials. Several experiments were made with new camouflage schemes, including light green and medium earth, but in the late 1980s the aircraft began to be painted in a definitive medium-grey air superiority scheme.

In mid-1995, Grupo 6 de Caza was formed with two Finger/Dagger squadrons, Escuadrón II and Escuadrón III, with 22 surviving examples.

Above: The Daggers had been built by IAI as Neshers. This Nesher S, seen sporting two kill marks and No. 117 Sqn badge, became Dagger A C-407 and was shot down on 21 May by a Sea Harrier.

Right: Grupo 6 had 37 Daggers on strength at the start of the war, but only about 25 were serviceable.

1 May 1982
Dagger debut

The second combat mission of the Fuerza Aérea del Sur (Southern Air Command) was the first for the Daggers, when a section from the Rio Grande-based squadron was launched at 07.45 on 1 May for an air cover sortie over the Falklands.

Left: The Rafael Shafrir missile was similar to the Sidewinder, but had a larger-diameter body. The Shafrir IIs used by the Daggers had a limited-aspect engagement envelope.

The configuration for this mission was two Shafrir II AAMs, 250 20-mm HEI (high-explosive incendiary) rounds and three 1300-litre (285-Imp gal) drop tanks. This section under the callsign TORO was crewed by Captain Moreno as leader and Lt Volponi as wingman.

When TORO was 50 nm (57 miles; 92 km) west of Port Stanley and at 22,000 ft (6700 m), the FAA radar controller (a Westinghouse AN/TPS-43E portable set) based near Stanley advised them of the presence of large numbers of Sea Harriers that had just raided the airfield. Two of the Sea Harriers (Lieutenant Commander Kent and Lieutenant Haigh from 801 Squadron) went head-on for the Grupo 6 Daggers: both sections crossed over each other, with the Daggers about 4,000 ft (1220 m) higher. They jettisoned external tanks to have more agility in a dogfight, but neither the British nor the Argentine pilots could see each other, and the four fighters started to fly in circles, trying to find out where the other was. Their decreasing fuel levels started to seriously worry the Grupo 6 pilots, who after some rapid mental calculation decided that it was better to return home. They turned west and pushed the throttles to full afterburner, climbing as fast as the aircraft could go, and reached 37,000 ft (11270 m), the best altitude for economical cruise. In spite of bad weather at Rio Grande, both aircraft, after an ILS approach, landed at this airfield without incident.

In this (bloodless) air engagement, both Argentine and British pilots thought that the other side had made use of air-to-air missiles, which was not the case; the impression was given by the drop tanks tumbling earthwards, trailing plumes of vaporised fuel.

At about 09.00, two Daggers were launched from Rio Grande with the callsign FOCO. The aircraft were crewed by Captain Mir Gonzalez and Lieutenant Bernhardt, who were tasked to provide cover to several formations of Skyhawks from Grupos 4 and 5. They also engaged the Sea Harriers in a similar manner to TORO section, and they too had to break contact and return home, which was accomplished without incident but with very little fuel left in the tanks.

By noon, the FAS (Fuerza Aérea del Sur) headquarters issued a frag order for a further air cover sortie. It was assigned to CICLON section, which found the skies over the Falklands empty of Sea Harriers.

The first Dagger missions were fighter sorties, armed with Shafrirs. Here a missile-armed aircraft is seen at San Julian.

1 May 1982
First Mirage loss

Following the first inconclusive meetings with Sea Harriers in the morning, the next Grupo 8 Mirage mission on 1 May was again CAPping over the Falklands, for which DARDO section was launched at 15.30 and BUITRE at 15.53. BUITRE – Garcia-Cuerva and Perona again – engaged a No. 801 Squadron Sea Harrier CAP flown by Flight Lieutenant Barton and Lieutenant Thomas north of Pebble Island at 16.10. The scene was set for the first air combat of the war. The Grupo 8 pilots approached with an altitude advantage, head-on, trying to entice the Sea Harriers into a vertical scissors manoeuvre. During their approach they only caught sight of Thomas, who was in the standard widely separated line abreast defensive battle formation with his leader. The Mirage pilots did not notice as Barton made a pincer movement towards the northeast, approaching them from behind. The Argentine fighters had been visually detected by Barton at about 8 miles (13 km). When the distance was reduced to almost half, Thomas saw what seemed to be the launching of missiles against them – once more, it was only the jettisoning of drop tanks. Perona and Thomas crossed very close, and the Argentine pilot could clearly discern details of the Sea Harrier's dark grey lower surfaces, as well as the drop tanks and Sidewinders. They were at 12,000 ft (3660 m). He tried to visually track the Sea Harrier and, when initiating a left turn, his Mirage (I-015) was hit by an AIM-9L fired by Barton in Sea Harrier XZ453. While the two Argentine interceptors had been in a smooth (about 2.5 *g*) turn, the British pilot had made a hard (about 6 *g*) turn to position behind them, getting a lock-on with his left-hand Sidewinder from about 1 mile (1.6 km). It was the Sea Harrier's first kill.

R530E-armed Mirages prepare for a mission from Rio Gallegos. Even with drop tanks the Mirages had no ability to descend and fight with Sea Harriers over the islands.

For Perona, the missile hit came as something of a surprise, but fortunately he could eject from his crippled fighter. He related: "The

tactical idea was for each of us to lock into a one-on-one combat. At that moment our aircraft and a Sea Harrier crossed each other, so I started what is known as a scissors manoeuvre – consisting of raising the aircraft to try to gain as much height as possible, turning and banking to port and starboard in order to try to gain advantage over the enemy, who is flying roughly parallel to you – to place my fighter at his six o'clock position. The Sea Harrier's characteristics enable it to decrease speed faster, plus I had trouble in controlling my Mirage at slow speed due to a drop tank hang-up. When I looked to one of the sides I noted that we were separated by about 100-200 m. I followed the Harrier until it disappeared from my field of view through the top aft side of my cockpit canopy. Just as I was starting to manoeuvre to eyeball the Sea Harrier again, I felt a big jolt. My Mirage started to shudder badly and I lost control, and the warning lights of the panel illuminated in quick succession. After futile attempts to control my machine, I ejected. I succeeded in heading my parachute towards land, since falling in the water at these latitudes is a last option. When I was some metres above the ground the wind pushed my parachute towards rocky terrain, so that I made contact with the ground in an unorthodox manner and injured both legs."

Perona was rescued some time later, and once in Port Stanley was evacuated to Comodoro Rivadavia in a C-130 Hercules. He spent most of the war in a hospital recovering from his wounds.

1 May 1982
Shot down by friendly fire

Moments after Perona was shot, Thomas in XZ452 approached to within firing range of the other Mirage (I-019) flown by Garcia-Cuerva. As he said: "I got a visual at about eight miles and saw that it was a Mirage. I could see his wingman, just to the right and behind, and I could not believe that a pair of fighters would come in like that. Their formation was poor, what the Americans call welded wing. I was trying to lock a Sidewinder onto him but the missile wouldn't acquire because the solution was wrong. At five miles the leader launched a missile, but I saw it diverge and go down to my left; at the same time something came off the second aircraft, it was tumbling. I began turning hard to the right, and passed about 100 ft above the top of their leader. I could make out every detail of the aircraft, its camouflage pattern, and see the pilot in his cockpit. I continued my turn towards the wingman, who was about 500 yards in trail on the leader's left. As I was in the turn, I passed over the top of Paul [Barton] as he was moving in to attack. I saw his guns firing. Then the rear man rolled off the bank and started a gentle climb, seemingly unaware that Paul was sitting behind him. My opinion was that these pilots were not very good, tactically they didn't seem to know what was going on. They both seemed aware that I was there, but I don't think they knew what Paul was up to.

"I saw the Sidewinder launched by Paul streak towards the wingman [Perona] – it exploded, and the rear end of the Mirage became a bright yellow torch. The front half of the aircraft remained more or less intact and shedding pieces, it continued on and upwards in a ballistic trajectory.

"Meanwhile, I was continuing my turn and the enemy leader [Garcia-Cuerva] was doing quite a descending turn to the left, going down very fast towards the top of the solid cloud cover at 4,000 ft. I rolled into a vertical descent behind him, locked-on one of my missiles and fired it. The Lima streaked after him and just before he reached the cloud I saw it pass close to his tail, then both the aircraft and the missile vanished."

The Sidewinder apparently exploded close to the low aft section of the Mirage, some shrapnel puncturing the fuel tanks and damaging the control runs. In an effort to save the precious aircraft, Garcia-Cuerva tried to land at Stanley airfield. After about five minutes, he was near the runway. The controller ordered Garcia-Cuerva to eject, but the Grupo 8 pilot was doing his best to save the damaged interceptor despite the risks of landing on a damaged runway, as Port Stanley's was. On short finals, Garcia-Cuerva jettisoned his Magic missiles in inert mode, pulling the emergency handle in the cockpit. AA defences were advised of the approach of a friendly aircraft, but nonetheless the nervous crew of an Argentine army 35-mm gun thought it was a British aircraft attacking and opened fire, hitting the Mirage almost immediately. Garcia-Cuerva's last words were "Hell, they hit me." The aircraft, enveloped in flames, rolled inverted and crashed into the water to the south of Freycinet Peninsula; he was the only Grupo 8 Mirage III pilot killed during the conflict.

35-mm AAA guns were deployed by the Argentines in some numbers to the Falklands. One shot down a badly-damaged Mirage.

1 May 1982
Anti-ship attacks

During the afternoon's early hours, Brigadier General Crespo – the FAS commander – received information that several Royal Navy ships had been detected southeast of Port Stanley airfield, probably readying for a shore bombardment mission. A fragmentary order was immediately issued to the air bases under his command to launch a new wave of strike and escort aircraft (the first one launched during the morning had found no naval targets). At 15.30 and 15.40, a pair of Dagger sections with the callsigns DARDO and FIERRO was launched from San Julian to provide cover for the fighter-bombers, followed by TORNO section composed of three Daggers each armed with two 500-lb bombs and three 1300-litre (285-Imp gal) drop tanks. Pilots of the latter section were Captain Dimeglio as leader, Lieutenant Aguirre as number two and First

Three Daggers with identification markings sit on alert at San Julian. For the first anti-shipping raid Grupo 6 provided both fighter-bombers and Shafrir-armed escorts.

Lieutenant Roman as number three. Five minutes later FORTIN section was launched as escorts with Captain Donadille and Lieutenant Senn as pilots. At 15.55 RUBIO section took off from Rio Grande, with only one of the two Daggers initially scheduled; its pilot, First Lieutenant Jose 'Pepe' Ardiles, did not abort the cover mission in spite of being justified to do so since his wingman developed a technical fault and had to abandon the take-off. It was a bad omen for the young Argentine pilot, cousin of a famous soccer star then playing in England.

Captain Guillermo Posadas, who was the maintenance officer of Escuadrón Aermovil No. 1 at San Julian, relates his feelings during the afternoon's missions on 1 May. "Close to 15.45, nine Daggers were launched – which out of 10 available at San Julian was a pretty good figure. It was very moving to watch from the ground as our friends in the fighter-bombers departed, heading east. At the runway threshold, with the Atar 9C turbojets at maximum power and afterburners engaged, the noise level was outstanding. The ground crews waved to the pilots before take-off and they – like knights from a futuristic epic, with their sun visors down and oxygen masks fitted – returned the salute. After the noisy take-off, those of us who remained at San Julian began to wonder: would they come back? would they drop their bombs and fire their guns? if they have to eject, would the ejection seat work? Truly, our concern only dissipated when, near the horizon line, over the sea we could discern the landing lights of the first Dagger approaching.

"About one and half hours after they took off, we received a message that our aircraft had engaged the enemy and that several British ships had been hit. We were very happy, mainly because all the Daggers were returning without damage. Sometime later, at dusk and after the last aircraft landed, we raced to meet the excited pilots who provided us with first-hand accounts of the attack. Then we all went to the squadron's ready room for an extensive post-mission briefing and to discover if there were any problems with the Daggers, so that we could get them all ready for the next mission. The war had started in earnest."

1 May 1982
The loss of Ardiles

Rio Grande's solitary RUBIO Dagger (serialled C-433), flown by Jose Ardiles, was over East Falkland when it was vectored by the Argentine GCI to a Sea Harrier CAP approaching from the northeast. Seconds later Ardiles 'tally-hoed' the Fleet Air Arm pair (he was spotted visually at the same time by the British pilots). The Dagger was at 33,000 ft (10060 m) and the Sea Harriers were at 20,000 ft (6100 m), and the three closed head-on. Ardiles started a shallow dive and launched a Shafrir missile against the Sea Harrier flown by Lieutenant Martin Hale from No. 800 Squadron: in spite of having been fired out of its parameters, the missile locked into its would-be victim, which turned away to evade it. The Shafrir pursued the Sea Harrier until 5,000 ft (1525 m), when it lost its lock-on and veered away, possibly having exhausted the rocket propellant, although it passed uncomfortably close to the Sea Harrier.

Meanwhile, Ardiles had started a hard climbing turn with full afterburner in order to maintain his altitude advantage over the STOVL interceptors. Flight Lieutenant Bertie Penfold from No. 800 Squadron in Sea Harrier XZ455 made good use of Ardiles's tactical disadvantage; the Dagger was silhouetted against the sky and provided a high IR signature. Penfold locked an AIM-9L and fired. The Sidewinder covered the 3 miles (4.8 km) separating both aircraft in a few seconds and ran up the Dagger's tailpipe. A bright fireball followed, in which the Grupo 6 fighter almost disintegrated. Some pieces of the aircraft fell on Lively Island, and the unfortunate pilot did not eject.

Grupo 4 A-4C and Grupo 6 Dagger pilots indulge in a game of darts between missions at San Julian. Note the intelligence photos of British warships on the wall.

The war's first air-to-air kill occurred at approximately 16.40.

At Port Stanley, the GCI controller heard the anguished cry of Ardiles – who at the last moment saw the AIM-9L's smoke trail and tried, to no avail, to avoid the missile in a hard break – disappear from the radio frequency while his aircraft's blip vanished from the radar screen. It had been an almost suicidal mission and the price paid was high, an aircraft and a pilot. Squadron commander Martinez should have ordered Ardiles not to take off when his wingman aborted.

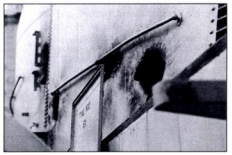
1 May 1982
Daggers reach the ships

At almost the same time that C-433 exploded, TORNO flight was approaching the Falklands. Said Cesar Roman: "About 100 miles (160 km) west of the islands we descended to about 30-50 ft (9-15 m) over the sea to avoid enemy radars and Sea Harrier CAPs. We were coasting their northern shores when TORNO 1 (Dimeglio) saw an object on the sea. We changed heading to attack it, but when we were nearer we found with some embarrassment that it was a solitary rock protruding from the ocean at the northern mouth of the Estrecho de San Carlos (Falkland Sound).

"When we arrived in the area where the enemy ships were supposed to be, we found nothing, but Dimeglio decided to continue to follow the coast's contours for several minutes. Near Stanley we could see artillery fire from shore positions. After changing the heading we saw three big grey warships in arrow formation engaging shore targets with their guns. The leader assigned a target for each of us and we accelerated, descending still more to avoid being detected. I did not fire my guns during the run for fear of being discovered. AA fire was very light and I think we caught them off guard. I dropped the two 500-lb parachute-retarded bombs into 'my' ship and, after taking some evasive action, I climbed over Isla Soledad (East Falkland) on the way home. We checked each other on the radio and were very happy to be all in one piece and alive.

"When we were at about 15,000 ft (4570 m) I saw an aircraft at two o'clock in a diving turn. I alerted the leader, informing him that it

Photographed on 2 May, Teniente Aguirre Faget was one of the TORNO flight pilots who attacked HMS Alacrity, Arrow and Glamorgan. The aircraft has a half-filled ship symbol.



HMS* Arrow *(above), a Type 21 frigate, was the first British warship to be damaged during the conflict, receiving a few 30-mm rounds (left) from TORNO flight. The Daggers' bombs all landed in the sea.

did not pose a threat since it was heading away from us. After the uneventful landing at San Julian, I was surprised to learn that the aircraft I had detected diving was no other than Dimeglio, who, following orders from the GCI, had gone to low level in order to avoid a Sea Harrier CAP that was closing dangerously.

"Due to the differences in fuel consumption between TORNO 1 and 2 and me, and since I did not hear the GCI alert call, I continued in my optimum cruise height while the others had to jettison their empty centreline tanks to create less drag. I gave them priority during the landing circuit. This was one of the missions in which the Sea Harriers followed us during our escape, but we were supported by FORTIN section which distracted their attention, as it seemed they were going after Aguirre."

The Type 21 frigates HMS *Alacrity* and *Arrow* plus the 'County Class'-destroyer HMS *Glamorgan* were caught by surprise, as Roman said. Fortunately for the ships, the six bombs fell into the water. Two or three were near misses that caused some structural damage to *Glamorgan* and *Alacrity*, and *Arrow* received 11 hits from 30-mm guns on its superstructure near the funnel.

During the TORNO section escape, they were pursued for about 80 miles (130 km) by a Sea Harrier section. Since the AAM-armed FORTIN section was nearby, it was directed to intercept the Royal Navy fighters. Low on fuel and with 'bogies' approaching in a stern conversion, the Sea Harriers split-essed and abandoned the chase.

These were the last sorties flown by Grupo 6 on 1 May. Events revealed to the Dagger pilots their insufficient fuel capacity to establish a CAP over East Falkland island for more than three to five minutes, and even that left them with no margin for mistakes in computing the best approach and egress profiles. Another factor was the difference among the Shafrir II and the Sidewinder 'Lima' missiles; although the former was not a bad weapon, the AIM-9L was much more advanced. Most important was the contrast in air combat training between the Sea Harrier and the Grupo 6 pilots. The former were then, and still are, among the best practitioners of modern air combat, and they were not lured away to engage the Daggers at high altitudes, where the Sea Harrier advantages diminished somewhat.

A Dagger and its pilot had been lost in a courageous but irresponsible act, engaging in combat without the support of a wingman, something vital in the air-to-air arena. From then on the Daggers were tasked almost exclusively with strike missions, mainly against British ships.

Escuadrón Aeromóvil Núm. II pilots pose by C-412 the day after their first anti-ship raid. Second from right is Aguirre, and fourth from right is Teniente Cesar Roman.

1 May 1982
Withdrawal of the Mirage

Soon after Garcia-Cuerva had been shot down by his own AAA, DARDO section returned to Rio Gallegos without engaging the Sea Harriers.

So ended, after 12 sorties over the Falklands, the first day of the war for Grupo 8 de Caza. During those missions the Mirages of the first batch carried a configuration of two 1700-litre (350-Imp gal) drop tanks and an R.530 radar-guided AAM, while the second batch added two Magics. This latter configuration was discouraged in the pilot's operating procedures manual, but the advice was not considered and the aircraft thus loaded operated with the usual margin of safety.

This first day of combat shocked the Mirage pilots, who, in addition to losing one of their comrades – an experienced flight commander – had lost two almost brand-new Mirage IIIEAs. Several issues arose which had to be considered during the remainder of the conflict. The first was the Mirage's clear disadvantage in the air-to-air arena against the duo of Sea Harrier/AIM-9L; the Sidewinder was more advanced than the R.530 or R.550 carried by the Mirages. Another matter was the Argentines' use of poorly developed aggressive tactics in air combat. Next came the lack of range, which made it impossible to reach the operations area, dive to lower levels to engage the Sea Harriers, and return.

For all these reasons, on the evening of 1 May the primary feeling among Grupo 8 de Caza pilots was one of frustration: they had been bettered by an enemy (the Sea Harrier) which they had underestimated, particularly from the aspect of the combat readiness of its pilots. Consequently, there was no point risking the few available Mirage IIIs in engagements in which they did not have a clear advantage.

Although not used in combat, Grupo 8's single Mirage IIIDA two-seater was deployed to Rio Gallegos to continue training. It wore theatre identification marks.

2-20 May 1982
Mainland alert

FAS staff were understandably worried that the Vulcan's next raids could be the southern Argentina air bases, mainly Río Grande or Comodoro Rivadavia. Accordingly, Grupo 8 with its 24-hour intercept readiness mission at Río Gallegos and Comodoro Rivadavia was ready in case the EW radars detected a threat. These alert duties were maintained all during the conflict and for a few weeks afterwards. It was terribly boring, sitting inside the Mirage III's narrow cockpit, enduring very low temperatures, without knowing what kind of missions they would be scrambled for, or even if their services were to be required at all. This the reason why fellow airmen from other FAA units called them the 'trench foot pilots'.

Major Sánchez, Grupo 8 operations officer during the conflict, related some of his experiences while on alert duty at Río Gallegos. "I made a couple of alert scrambles, searching for low-speed contacts, probably helicopters flying very close to the Argentine/Chilean border in Tierra del Fuego. Usually, the bogey entered Argentine territory, we scrambled, it returned to Chilean territory, the radar lost it and we remained on patrol until reaching bingo fuel. One night we patrolled over Tierra del Fuego, near Río Grande looking for some bogies which we could not fix. Although we did not have RWR on the Mirages at the time, through the IFF we could identify if the Chilean radar at Punta Arenas painted us.

"We were at permanent readiness and had the capability to cover any type of mission. This was a role we knew perfectly, thanks to the operational exercises we did regularly. Consequently, we were adept at air defence and interception in all kinds of weather.

"I'd like to emphasise that personnel were trained to endure these intense efforts. On some occasions there was a one-pilot-per-aircraft ratio at Río Gallegos, but, in spite of this, all the Mirages were on 24-hour alert for more than a week. This alert covered all the FAS bases and also Río Grande, and at the same time we had to make top cover and decoy missions over the Malvinas (Falklands). When returning from such missions we had to quickly turn the Mirages around, then go on stand-by alert and perhaps scramble again. In one instance, I returned from an escort sortie which lasted for more than two hours. After landing, my aircraft was being refuelled at the ramp when I received an urgent scramble order, so the refuelling was cut short and I launched with only internal fuel."

The threat of RAF Vulcan raids and continuing difficulties with neighbour Chile kept the Grupo 8 Mirages busy on alert at their southern bases.

Alert operations at both Río Gallegos and Comodoro Rivadavia were demanding on the Grupo 8 crews, as there were few combat-ready pilots.

4-20 May 1982
Rest before the storm

On 4 May 1982, two Dagger sections from Escuadrón Aeromóvil No. 1 were launched at 10.20 and 15.00 respectively from Río Grande to provide escort for two Grupo 1 de Transporte KC-130H Hercules tankers which refuelled the pair of Aviación Naval Super Etendards attacking the HMS *Sheffield*. The aircraft used the callsigns TANGO (Robles/Cimatti) and MATE (Dimeglio/Mir Gonzalez). The mission was uneventful.

During the following days weather conditions were very bad and no missions were flown.

On 9 May the skies cleared somewhat. Accordingly, two fragmentary orders were issued to San Julian and Río Grande respectively, indicating possible naval targets near Port Stanley. The first to launch, at 13.46, was PUMA flight with four Daggers, followed at 15.09 by Jaguar flight with the same number of aircraft. Unfortunately for the Argentine pilots, a few minutes before arriving at Jason Island (north-northwest of West Falkland) they had to turn back due to very low cloud cover, gusting winds and rain/snow showers.

Three days later, on 12 May, a combined attack was planned by two flights of A-4Bs from Grupo 5 de Caza and another two of Daggers. They were to attack Royal Navy warships engaged in shore bombardment, but due to technical and communication problems it was impossible for the Grupo 6 aircraft to participate; the Skyhawks went alone, and suffered heavy losses.

The days passed with some alerts and a few unproductive local air defence scrambles, mainly caused by radar contacts from inside Chilean territory in Tierra del Fuego. At that time, the FAA feared a Chilean pre-emptive raid in an attempt to resolve the Beagle Channel dispute in Chile's favour, but other evidence indicates that a pair of RAF Canberra PR.Mk 9s may have been secretly deployed to Chilean bases.

The evening of 20 May was very tense for the Grupo 6 personnel stationed at San Julian and Río Grande: rumours were rife about possible British landings on the islands, and even a possible SAS/SBS commando raid to Río Grande to destroy the Argentine navy Super Etendards was mooted. Most of the pilots slept little that night, the eve of dramatic events.

This group shot shows Dagger pilots at San Julian on 2 May. Apart from escorting the Super Etendards which attacked and crippled HMS* Sheffield *with an Exocet, and a handful of abortive sorties and local air defence missions, it was to be 19 days before the Daggers went back to war with a vengeance.

21-27 May 1982
Mirages over San Carlos

The period of 2 to 20 May was relatively quiet for the Mirage fleet, although everyone was under the strain of not knowing what course events would take. The British landings in San Carlos and adjacent areas caught the FAS by surprise, since they were not expected in that area in spite of the portent of the SAS (Special Air Service) raid on Pebble Island airstrip a week earlier. Notwithstanding, strike and air cover missions by the Mirage IIIs commenced almost immediately. In the so-called Battle of San Carlos between 21 and 27 May, the Mirage IIIs made 18 sorties from Río Gallegos (they were all now concentrated at that base). During these seven days, the Grupo 8 interceptors had a high availability rate, close to 100 per cent. No aircraft dispatched to the operations area engaged the Royal Navy CAPs, because the Sea Harriers were very successful at low level and had no interest in climbing to high altitude to engage the Mirages (which, due to the range problems explained previously, could not descend to lower levels to engage).

Former Grupo 8 commanding officer Carlos E. Corino explained the Argentine tactics: "Basically, our aircraft operated only at high level for they had the advantage under these conditions, and lost it when they went lower to engage. We had full knowledge of our advantages and disadvantages and, naturally, the British were also perfectly aware of our troubles. To have more fully exploited our advantages, we should have had a better guidance (GCI) capability. Although the Mirage III has a search-and-fire control radar, guidance had to be provided from the ground-based GCI station until we were in a favourable attitude with respect to the enemy, i.e., within the range of the onboard Cyrano radar's theoretical 25-nm search range. Our interceptors operated on the extreme edge of their radius of action, and even at the best of times could not stay on CAP over the islands for more than a few minutes at high level. The Sea Harrier pilots had a far better guidance capability with a respectable number of destroyers/frigates with highly experienced fight controllers aboard. After the 1 May combat, there were only a few (uneventful) skirmishes in which the Mirages were in a favourable position, in which case the Sea Harriers disengaged, and vice versa if the Mirages lost the advantage in altitude."

By the time of the British landings at San Carlos, all of the deployed Mirages were at Río Gallegos, which was closer to the islands.

The second batch of Mirage IIIEAs could carry two of the MATRA R.550 Magic missiles, seen here on two aircraft at Río Gallegos. Note the Grupo 5 A-4B in the background.

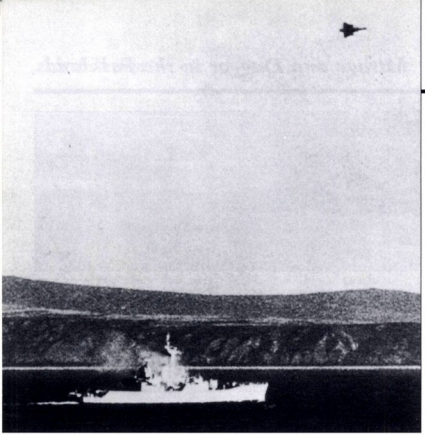
21 May 1982
San Carlos Dagger attacks

21 May dawned cold and humid but with clear skies. On the Falklands the weather was similar, although a front was approaching.

At Comodoro Rivadavia air base, headquarters of the FAS, CO Brigadier General Ernesto Horacio Crespo was nervous and impatient. He had been up since 05.00 and had not since left the war room, trying to obtain reliable information from the islands; the last thing he wanted was to send his boys against phantom targets. Then, at about 08.30, sketchy information arrived about British landings at the north of the Falkland Sound, but there was no confirmation. Two hours later, confirmation was received that it was not a feint and that the British were establishing a beachhead at San Carlos.

Some time previously, Brigadier General Crespo had sent some of his aircraft on armed reconnaissance missions to find and attack the British ships. ÑANDU flight was launched at 09.44 from Río Grande, piloted by Captain Rodhe, Lieutenant Bean and Captain Janett. PERRO flight

The 'County'-class destroyer HMS* Antrim *was hit by PERRO flight, one bomb lodging in the 'heads' (toilets), but not exploding.



***A Dagger flies at uncharacteristically high altitude across San Carlos Water. The British frigate is a 'Rothesay'-class, either HMS* Plymouth *or* Yarmouth.**

departed one minute later and was formed by Captain Moreno, Lieutenant Volponi and Major Martinez. Each Dagger was armed with a single Mk 17 1,000-lb bomb and two 1700-litre (375-Imp gal) tanks. Captain Diaz, Lieutenant Aguirre and Captain Dellepiane were launched at 09.53 from San Julian with the callsign ZORRO, while Captain Dimeglio and Lieutenant Castillo were LEON.

At 10.25 the first Daggers arrived at the San Carlos area, where ÑANDU flight attacked the frigates *Broadsword* and *Argonaut*. Only the former suffered damage, in the form of several hits by 30-mm gunfire from Bean and Janett. A Sea Wolf missile launched from the Type 22 frigate hit Bean's Dagger; he was killed, as C-428 disintegrated just above the water. PERRO flight was the next in the attack and went for the 'County'-class destroyer HMS *Antrim*, which received a direct hit. The Mk 17 bomb went through several compartments and came to rest without exploding in the Sea Slug missile storage room. The unfortunate warship also received several 30-mm rounds. Due to this damage, *Antrim* was temporarily out of action, seeking refuge in San Carlos Water to make emergency repairs and deactivate the bomb.

Meanwhile, the remaining Daggers escaped unscathed from the inferno of AA and missile fire, overflying the sound on a southerly course. One of the fleeing Daggers was very lucky when a Sidewinder launched at extreme range by Lieutenant Martin Hale from No. 800 Squadron did not make contact because the missile exhausted its rocket propellant and fell off. Hale and his element leader tried to get into range but the Daggers, without drop tanks, were going extremely quickly, and the Sea Harriers had to abandon the pursuit due to fuel shortage.

At 10.51 ZORRO flight made its appearance in the battle area, attacking the frigate *Brilliant*. Although an electrical failure prevented the bombs being dropped, the Grupo 6 pilots emptied the 30-mm guns' magazines into the frigate, which received at least 20 hits. The operations room and the wardroom were affected, and several crew members were wounded. Two minutes later LEON section attacked two ships with bombs and cannon, but caused no damage.

21 May 1982
Second Dagger loss

The third wave of Argentine aircraft (the second was exclusively composed of A-4B/C Skyhawks) began to take off in the early afternoon. CUECA flight was launched from Rio Grande at 15.55, formed by Captain Mir Gonzalez, Lieutenant Bernhardt, Captain Robles and First Lieutenant Luna. Five minutes later LAUCHA flight was launched from San Julian with First Lieutenant Roman, Major Puga and First Lieutenant Callejo as pilots, and a few minutes later it was the turn of RATON flight, from the same airfield, with Captain Donadille, Major Piuma and First Lieutenant Senn.

The four Daggers from CUECA flight flew at very low level and went 'feet dry' over the islands, heading east through a valley formed by Mt Maria and Mt Robinson of the Morandy chain. The weather conditions forced them to fly lower than the hill-tops, some of which were covered by a deep cloud blanket. They flew in trail formation, the only possible configuration in these conditions. Between the mountains on both sides the leader could see something resembling a hole between the cloud cover and the valley, and through it went the four Daggers. They were roughly north of Chartres Settlement when the Argentines were detected by radar, and a Sea Harrier CAP from No. 800 Squadron lost no time going after them.

Robles and Luna (Nos 3 and 4 respectively) were visually detected by Lieutenant Commander Frederiksen aboard Sea Harrier XZ455. The Royal Navy pilots firewalled the throttles and approached to launching distance of the AIM-9L. With the growl tone growing on his headset, Frederiksen pressed the button, and the missile on the left pylon headed for CUECA 4. Just before impact, the Grupo 6 pilot saw from the corner of his eye the Sea Harrier flown by Sub-Lieutenant George (Frederiksen's wingman), and urgently tried to alert his comrades. The events that followed are narrated first-hand by Hector Luna.

"A few seconds after seeing the Sea Harrier, and while I was still trying desperately to alert the other members of the flight, I saw a fireball through the cockpit's rear view mirrors. I immediately felt the missile hit my aircraft, which went out of control, with the stick useless in my right hand. I tried to climb but to no avail, and then the aircraft rolled inverted. I thought I was a dead man. Releasing the stick, I frantically searched for the upper face blind ejection handle. I think the aircraft was upright when I found the handle, because the ejection was normal. I felt the explosion, a great noise, then a jolt, and the chute opened almost at the same time as I hit the ground. I hit very hard, breaking my left shoulder and dislocating a knee."

Luna's Dagger, serialled C-409, had crashed about 20 km (12 miles) west of Port Howard, uncomfortably close in his opinion. Next day, the wounded Grupo 6 pilot was found by a group of kelpers, who helped him make radio contact with the Argentine HQ at Port Stanley. Luna was recovered by a Grupo 7 Bell 212 helicopter and flown to Goose Green, and then to Port Stanley. On 25 May he was evacuated to Comodoro Rivadavia in a C-130 Hercules.

C-403 is seen with three tanks and armed with two 500-lb (227-kg) bombs at San Julian. The wing tanks have yellow identification marks.

21 May 1982
Attack on *Ardent*

Robles was unaware of what had happened, or that Frederiksen fired about 200 30-mm rounds at him, without making contact. Mir Gonzalez and Bernhardt were unaware that George had tried to hit them with 30-mm gunfire, albeit unsuccessfully. All three were too concerned with trying to avoid crashing while flying through the narrow valley. Once they found the exit, Robles broke radio silence to say that Luna had disappeared behind him. They thought he had crashed against a mountain during the last stage of the dangerous low-level navigation.

The diminished CUECA flight crossed the eastern shore of West Falkland and were over the waters of the Sound, when, at about halfway, they spied the frigate HMS *Ardent* at Gantham Sound, south of San Carlos. They made a heading correction to attack the ship across its stern. The Daggers received light AA fire, and when within effective range they opened up with their guns and dropped the Mk 17s. Mir Gonzalez's bomb fell about 12 m (40 ft) short, creating a large column of water, then somersaulted and imbedded itself without exploding in the stern. Bernhardt's bomb also struck the stern, but this one exploded: it destroyed the Lynx helicopter, demolished the hangar and the Sea Cat launcher, and caused several dead and wounded among the crew. Robles's bomb fell in the water without doing any harm.

The three remaining members of CUECA flight egressed through Falkland Sound on a southerly heading, and after almost one hour arrived back at Rio Grande without further trouble. HMS *Ardent* was badly wounded, although it still had some fighting power left, and set course for San Carlos Water in order to get support from other ships and to effect emergency repairs.

A Catholic priest provides moral support to two war-weary Dagger pilots. The geography of San Carlos Water limited the directions of attack, while the British had in place a forest of air defences.

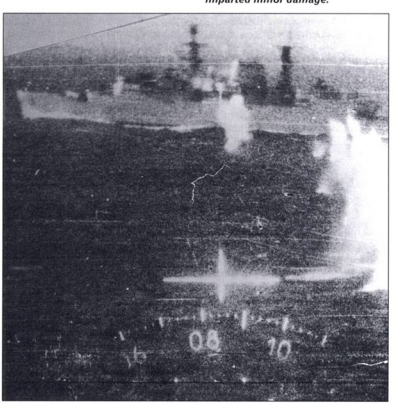
21 May 1982
Daggers hit *Brilliant*

21 May 1982 dawned very cold but clear at San Julian, a civilian airfield located close to the town of the same name on the Patagonian shore, between Comodoro Rivadavia in the north and Rio Gallegos in the south. At this provincial airfield, converted to a rudimentary air base, the small parking apron had been augmented by adding pierced steel planking to provide a minimum dispersal area for the two combat squadrons deployed there since the end of April, an A-4C Skyhawk unit and Escuadrón Aeromóvil Número 2.

Of the six Daggers that took off from San Julian, the first to arrive was LAUCHA flight, whose attack is described by Cesar Roman. "The last stage of the flight was made bordering the northern coast of Gran Malvina Island (West Falkland). Once Rosalie Mountain was passed we found the Sound's waters and, after flying very low, we discovered that we were higher than expected. The eastern shore is high and abrupt, so we pushed the stick forward to scrape the waves and thus avoid the ship's radars. I saw a warship near San Carlos Water, with some flames and a long column of smoke pouring from it, the result of an attack by another Dagger flight. With my No. 3 (Major Puga), I attacked a frigate. The ship's AA armament raised a wall of water, and in fact I went through one of these geysers, which considerably reduced visibility and aiming. Together with No. 3, I fired the cannon and dropped the bombs, then we egressed at full speed on an easterly heading while No. 2 attacked another warship to the north of us.

"After the attack, we had to change course just one minute after dropping the bombs in order to follow an escape corridor prepared during the mission's navigation planning. As I overflew the frigate, I triggered the chronometer and said over the radio, 'Forty seconds to go,' so my No. 2 would know how much time remained before he had to change his heading. During the attack run Major Puga had noted that something had struck his aircraft, so on the return leg, while we were climbing to cruise height, I closed in to observe his Dagger from several angles. I found nothing abnormal. After we landed, a hit was detected on the front armoured windscreen at about the same level as the pilot's helmet, but fortunately the bullet or shrapnel piece had only dented the glass without piercing it. After our expected happiness at being back home in one piece, we learned that RATON flight's return time was overdue, and the next day we learned that its three members had been downed by Sea Harriers, but all survived."

Roman and Puga had attacked the frigate HMS *Brilliant* but their bombs missed, although the ship received several 30-mm rounds that caused slight damage and causalities. Callejo attacked a vessel described as a frigate but his bombs exploded in the water. The three members of LAUCHA flight escaped, pursued by a curtain of tracer fire and even some missiles.



LAUCHA flight attacked HMS* Brilliant *(right), a Type 22 frigate, although the bombs missed. Below is a gunsight still from a Dagger during the attack.* Brilliant *took several 30-mm HEI hits which imparted minor damage.

21 May 1982
RATON flight's mission

Guillermo Donadille had arrived at San Julian with the rest of the squadron on 25 April in a non-stop flight from Tandil air base in the province of Buenos Aires. Donadille was then a captain in the Fuerza Aérea Argentina, with close to 3,000 flight hours, half of them in fast jets: A-4B/Cs and Daggers. On 1 May he flew an escort mission for a strike-configured Dagger flight, in the course of which some British warships were lightly damaged.

During the next 20 days Captain Donadille logged many hours in cockpit alerts and a few scrambles, all unproductive and very boring.

The events of such a dramatic day as was 21 May are described graphically by this Grupo 6 flight commander.

"On 20 May I received a parcel from home containing letters, a scarf and some chocolate bars. I found the letters, mainly written by my children, deeply moving.

"On the next day [21 May] I woke up before dawn. I left my room to watch the sun rise over the eastern horizon; it was very cold and windy, but clear skies promised a good flying day. Soon afterwards I started my alert duty as section leader for any possible escort sortie for strike aircraft. The sleek Daggers are configured for this role: three 1300-litre drop tanks, two Shafrir 2 AAMs and 250 HEI rounds for the two 30-mm DEFA guns. Just after entering the pilots' room (the airport's hall), we were informed that the British were making an amphibious landing at Isla Soledad (East Falkland) near the northern mouth of Estrecho San Carlos (Falkland Sound).

"We had to change the weapons configuration of the Daggers, loading them all with bombs. Initially there was a great deal of confusion: orders, counter-orders, nerves. Take-off time for the first flight approached and, since I was scheduled to participate in the second, I gave as much help as I could to my friends from the first wave, consisting of six Daggers. The 6,500-ft runway was a little on the short side with the Daggers at their maximum take-off weight. I prayed for them to return in one piece. With nervous expectation I waited, then almost two hours later the Daggers appeared from the east, all six of them! After landing and climbing out of the cockpits, the pilots, still with adrenaline flowing, narrated their experiences with the British air defences, and all at the same time: 'very thick', 'terrific', were some of the remarks, and another pointed out 'San Carlos Water is full of ships'. Certainly it was a full-scale amphibious operation and not a feint as we had thought before. The aircraft were checked out and two of them were found to have some rifle-calibre bullet or shrapnel holes.

"I began to get ready for my mission. I was assigned as leader of a three-aircraft flight in number C-403, with Major Gustavo Piuma in C-404 as No. 2 and First Lieutenant Jorge Senn in C-407 as No. 3. This latter pilot had been my pupil at the Aviation School several years ago and I taught him to fly while I was an instructor there. During the exhaustive briefing we received all the necessary information: radio frequencies, type of formation, armament load, weather forecast en route and over the target, probable Sea Harrier CAPs, etc.

"Afterwards we donned the heavy and cumbersome personal equipment, wool inner clothing, pullover, anti-exposure rubberised flight suit, flight boots, anti-*g* suit, survival and life vest, helmet, oxygen mask and flight jacket. To all this gear I added an individual touch, a thick scarf in the Grupo 6 colours of blue and dark red. During the external walkaround I noticed that the two bombs and three drop tanks were correctly fixed. I climbed into the tight-fitting cockpit and with the help of the crew chief I got the harness fastened and made all other connections. After wishing me good luck with a worried expression in his eyes, he removed the ladder and I closed the canopy. Then I was isolated from the outside noises and chilly wind, immersed in my world of instruments, switches and dials, which started to come to life through the actions of my gloved hands. Through the earphones in my helmet, I heard the voice of my No. 3, slightly distorted because the mask was not properly strapped.

"RATON 3: 'Ready to start up.'

"I did not hear No. 2 checking in. The time for take-off was near and it was necessary to meet the schedule; to hell with him if he's not ready, I thought, I'll leave him behind. I gave the order to start the engines. Diluted by the noise of the Atars, I faintly heard No. 2. He had a small technical difficulty and begged me to wait for him since he did not want to abort the mission. The other flight (LAUCHA, also with three Daggers) was ready and I called its leader, Cesar Roman, to tell him about our problem. I advised that LAUCHA should take

A pair of Daggers rests between missions at San Julian. They (C-419 and C-430) were the two aircraft downed by Andy Auld on 24 May over San Carlos. On 21 May, the ill-fated RATON flight lost three of its number to 'La Muerta Negra'.

off first, although it had been scheduled that we would go first, but that was the only way we could meet the established TOT (Time on Target). This change proved fatal to us.

"We became airborne on the last few feet of San Julian's short runway due to the heavy load carried by our trusty Daggers; it was an agonising experience. The shore was left behind with the swarms of seagulls. Now we were surrounded by an unforgiving ocean. The emotionless voice of the controller reminded me that I was on course. We also left the good weather behind, and just ahead I could discern heavy cloud build-up. Near the islands we descended to about 10 m over the dark grey ocean, and at the same time increased our speed to 800 km/h. Senn saw the Sebaldes Islands (Jason Islands) to our left, so I swivelled my head and through the mist and rain showers I could just make out this small group of little islands which serve as a navigational fix. We were about 20 seconds ahead of the estimated time and a little off course.

"A few minutes later, we crossed the northwest coast of Gran Malvina (West Falkland) Island. The weather got worse, with heavy rain showers, and the visibility diminished alarmingly. I was concerned about the mountains ahead because we were very low.

"With a glance to both sides, I could see the wingmen at the same level I was flying and bouncing up and down in the turbulent air. Three minutes from the target I called, 'Accelerate now!' I pushed the throttle forward to maximum dry thrust. We were going very fast over a yellow-greenish undulating landscape. On each side rose inhospitable hills, while a cloudy sky bathed the area with a grey light.

"One and half minutes from the target, my muscles tensed instinctively and my mouth became drier by the moment. In reflex, I leaned forward in the Dagger's small cockpit, setting my attention on the gunsight, and through its illuminated signs I could see the ground below, too close for comfort. Following this course, we went directly into the sound with no need to make corrective manoeuvres, thus giving fewer advantages to the enemy.

"'Sea Harriers at three o'clock!' The tense voice of Jorge Senn almost stopped my heart. I turned my head and to our right I could see the unmistakable silhouette of a Sea Harrier about 300 m above our flight. I had the strange feeling that his wingman was behind us. At almost the same moment the British pilot saw us and started a diving turn towards us.

"'Eject bombs and tanks, break right, go!' I ordered, and at the same time I did the same in order to engage the Sea Harrier head-on. One of my wingman hesitated, so I repeated the order. I saw his underwing stores separate from the aircraft, which, without all that drag, leaped like a frightened rabbit and crossed in front of me.

"The British pilot maintained a convergent heading to my aircraft in a shallow dive. I pressed the gun trigger from a distance of 700 m, and I think the flashes from the guns surprised him. My burst went high over his cockpit without doing any harm.

"I made a 90° bank and initiated a rudder dive, lowering the nose and trying to avoid losing the Sea Harrier beneath me. I fired again. The ground was approaching very quickly indeed, and my windscreen was completely filled by a dark grey fuselage flanked by two big intakes and a pair of short swept wings.

"Stick to the stomach, careful with the yaw, I felt the *g* forces pressing me against the seat, and the anti-*g* suit inflated to prevent the black-out. I saw one of my wingman passing over my left side on a hard level turn. I half rolled the Dagger and, while upside down, I saw that aircraft going away from me with a bright flame pouring from the tailpipe, indicating he was in full afterburner.

"Then I heard a small detonation, not very loud, as if somebody had crushed a paper bag beside my ear. My aircraft went out of control, first pointing into the clouds above, then started a frightening pitching motion that flattened me against the seat or made me float with all the dirt rising from the cockpit's floor. Suddenly, the Dagger started a series of fast rolls – parallel to the ground – and the control stick felt soft. Due to the speed of the aircraft and closeness to the ground I thought that my life on this earth was reaching its end, and a strange kind of fatigue invaded my body; but then the survival instinct which is so deeply rooted in combat aviators told hold and with both hands I pulled the lower ejection handle. I ejected when the Dagger was almost upside down, but the chute opened, and seconds later I made a very hard landing. I could not see very well since my eyes were affected by the high-speed wind blasting at my face during the ejection, but thankfully I had no other injuries. I concealed the parachute and got away from my landing area, all the time hearing the 30-mm rounds cooking off in the fire of the unfortunate C-403 which had crashed about 300 m from where I landed.

"I walked for one hour and 15 minutes following a line of telegraph posts. I found an old plough and a wooden hut in ruins; breaking a door, I took a pair of long boards and assembled a small shelter as night approached. I filled a sac with grass as a sort of makeshift pillow and was ready to spend the longest night of my life. My family and my Grupo 6 comrades back at San Julian and Río Grande seem very, very far away in the cold night. It was an incredible cold which seemed to come in waves and prevented me from sleeping during those endless hours.

"With dawn the sky became clearer. My worry faded about having any kind of back injury due to the ejection, as this kind of problem commonly appears several hours after an ejection. Fortunately, I had no trouble getting on my feet.

"That day [22 May] I walked about 25 km, following a small compass that was part of the survival gear. I knew something about the islands' geography, thanks to having carefully studied the maps. At about 15.00 I arrived at my destination at Port Howard, where an Argentine army infantry regiment is quartered.

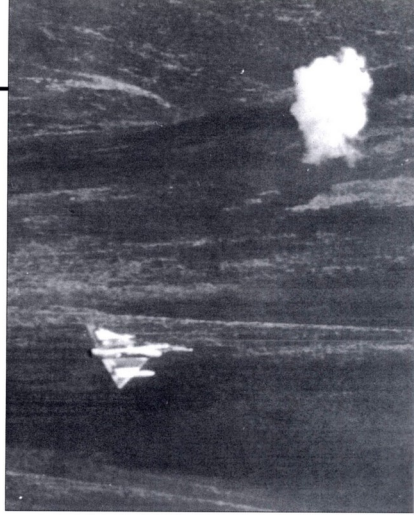
"More dead than alive from tiredness and dehydration, I was still happy that I would be able to send messages to my family and my comrades at San Julian. I stayed with the army and was joined by other ejected pilots – including both of my wingmen – and then we were flown by helicopter to Port Stanley. Towards the end of May we returned to the mainland aboard a C-130."

This first-hand account provides details of the drama which attended most of the Fuerza Aérea combat sorties from the mainland. They were very courageous pilots, but were not very well versed in the skills of modern air-to-air or air-to-ground tactics; nonetheless, these men provided ample proof of their valour.

Four downed Argentine aircrew are seen at Río Gallegos shortly after returning from the islands by FAA Hercules. Seated, from left to right, are Primer Teniente Luna (CUECA flight), Mayor Piuma and Primer Teniente Senn (both from RATON flight), and Teniente de Navio Arca (naval A-4Q pilot who ejected near Port Stanley). All four were shot down on 21 May during the epic anti-shipping raids against the San Carlos anchorage.

21 May 1982

The other side of the coin



A Dagger dodges naval AAA has it flashes across San Carlos Water. The large identification panels on the upper wing are clearly visible.

In the previous lines a Dagger pilot tells his dramatic story; here is the account of the pilots who shot down RATON flight, Lieutenant Commander Nigel Ward and Lieutenant Steve Thomas from No. 801 Squadron, Royal Navy.

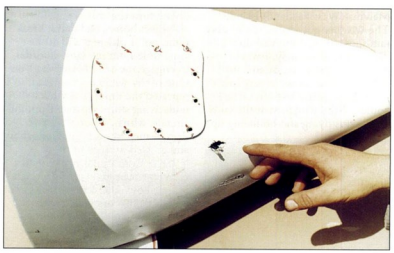
Said Thomas: "On the third sortie of the day [21 May], I was flying Sea Harrier 009/ZA190 and was wingman to Lieutenant Commander Nigel Ward. We were patrolling at 1,000 ft in valleys 15 miles northwest of Port Howard. I saw two Daggers together, flying east quickly at very low level. I manoeuvred in behind and locked-on and fired a missile at the closer aircraft [Piuma]. The Dagger blew up and crashed, and then the leader [Donadille] of the Dagger element pulled up and right (presumably going home fast!). I locked-on and fired at him my second and last AIM-9L, and the missile guided well and went over his port wingroot, causing a bright orange flash against the aircraft. We could not see what happened to him since Ward (and I) had seen a third Dagger crossing ahead of us, which Ward destroyed with a Sidewinder. Total time, about one minute. It was subsequently found that my second Dagger was lost also, but fortunately all three pilots ejected safely."

Said Ward: "The Dagger [Senn's] changed to a westerly heading. I was at 300 ft over the terrain, dived after him, got a lock-on and fired an AIM-9L. It couldn't fail! Seconds later it hit the target and, as if in slow motion, I saw the Dagger disintegrate. It hit the ground, then the right engine intake and the wing's leading edge from the same side cartwheeled among smoke, flames and debris. I did not observe an ejection, but later learned that the pilot had done so and survived."

21 May 1982

The day's account

These engagements brought an end to the missions of Grupo 6 de Caza during the dramatic day of 21 May. The Fuerza Aérea Argentina had launched 54 sorties from mainland bases (of 63 initially planned) and lost seven aircraft, an alarming 13 per cent. As for Grupo 6, its losses were very heavy: 23 escort and attack sorties were undertaken and five Daggers did not return, resulting in a loss per sortie rate of a staggering 22 per cent. The fate of the five pilots was not known at the time, but during the night of 21/22 May news reached Comodoro Rivadavia that four of them had been recovered.



Small arms fire caused this damage to a Dagger intake shock cone during the Battle of San Carlos.

A number of factors had contributed to the high losses. They included the low experience level of the pilots in the Daggers (compared to the A-4B and C), and the lack of a sound tactical background in anti-shipping operations and mutual support when attacked by enemy aircraft. Perhaps the worst mistake was that they targeted the warships instead of the transports. On the plus side – although little was known then – the Daggers had caused heavy damage to the frigate *Ardent*, moderate damage to the destroyer *Antrim* and light damage to other vessel. Other measures were studied during that night, especially the flight profiles over the islands in an effort to avoid the Sea Harrier CAPs.

More small arms damage, this time to a Dagger's undernose radio antenna. Grupo 6 lost five aircraft on 21 May.

23 May 1982

Loss of Volponi

On 22 May there were no Dagger sorties due to bad weather conditions. Next day it improved a bit and at 08.43 two flights were launched from Río Grande, but they had to turn back due to very low clouds over the islands. During the afternoon, at about 15.00, three sections of Daggers were over the Falklands: PUÑAL – Major Martinez and Lieutenant Volponi; DAGA – Captain Rodhe and First Lieutenant Ratti; and CORAL – Captain Dimeglio, Lieutenant Aguirre and First Lieutenant Roman. The first flight was from Río Grande, and the other two had been launched from San Julian.

Alerted by the FAA radar controller that there were CAPs nearby, PUÑAL dropped their bombs and turned home at low level; both Daggers were detected north of Pebble Island by Lieutenant Commander Auld, CO of No. 800 Squadron, and his wingman, Lieutenant Hale.

Martinez was going too quickly to be caught, but Volponi in C-437 had delayed pushing the throttle to the firewall and was some way behind. Hale in ZA194 was about 2 miles (3 km) behind Volponi and, when the distance had been reduced to 0.5 mile (0.8 km), he launched a Sidewinder. The unfortunate Grupo 6 pilot did not try any evasive manoeuvres and the missile flew up the Dagger's tailpipe. The doomed fighter-bomber exploded in a brilliant flash and began to disintegrate, cartwheeling into the ground west of Elephant Bay on Pebble Island. Volponi was killed.

24 May 1982

Back to San Carlos

On 24 May AZUL flight attacked landing ships in San Carlos Water, including* Sir Bedivere, *seen here in the pipper of Capitan Carlos Maffeis's Dagger.

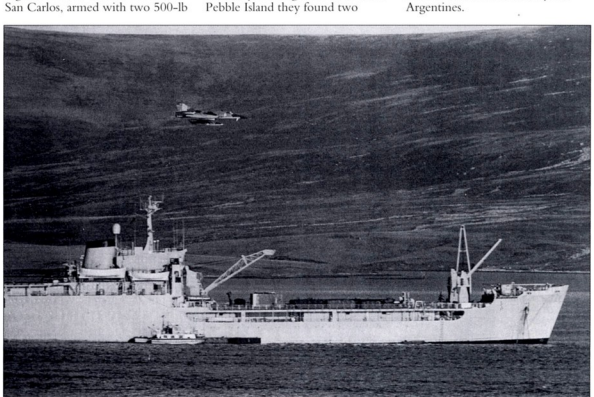
On 24 May the FAS planned a total of 12 fragmentary orders for attacking British shipping in San Carlos Water. At 11.02 the first Dagger flight arrived at the area. It had the callsign AZUL and was from Escuadrón Aeromóvil Número 1. Each Dagger carried two 1700-litre (7,730-Imp gal) drop tanks and one Mk 17 on the centreline station. No. 3 of the formation was Captain Carlos A. Maffeis, who describes the attack thus:

"AZUL flight, of which I was part, was composed of four Daggers briefed to attack naval targets within San Carlos Water. As I remember, our flight was the first to arrive and in some way we surprised the British; perhaps this is why the four of us exited the area in one piece, although not before getting hit by small arms fire. On that day I was flying aircraft C-431 and my place in the formation was as section leader (No. 3). My wingman was Captain Robles, and the flight leader and his wingman were Captain Mir Gonzalez and Lieutenant Bernhardt, respectively. Lieutenant Bernhardt was shot down some days later in this same place.

"As usual, we ingressed at very low level and after we crossed the Bahía Ruiz Puente (Grantham Sound) and the nearby hills on a south to north route, we entered San Carlos. Contrary to my three flight-mates, I went over the eastern shore where there was a major accumulation of ships. On the west side there was a big transport. My decision to attack smaller vessels was based on the fact that, four minutes before, the generator of C-431 had failed and with this breakdown the bombs could not be dropped. It was a limitation of the aircraft's electrical circuit and I could only fire the two 30-mm guns. I pulled the trigger three times: the first shots were short and raised big plumes of water, but the next may have impacted on the target.

"All this happened very quickly but, as in other engagements, it remains firmly recorded in my mind. When the gun camera films were developed they revealed – in addition to such technical details as a 350° attack heading – six ships , or about 50 per cent of all British vessels in San Carlos Water."

AZUL flight caused only light damage to the amphibious ships, but the four Daggers were still extensively photographed by the British. Fifty minutes later PLATA flight from Río Grande arrived at San Carlos, armed with two 500-lb parachute-retarded bombs each. The pilots were Captain Dellepiane, First Lieutenant Musso and Lieutenant Callejo. Once bombs had been dropped over the targets, the aircraft egressed on a northerly heading. Ten miles from Pebble Island they found two warships; one ship fired SAMs, which from their size the Dagger pilots thought were Sea Darts. Fortunately for the Grupo 6 pilots, their evasive manoeuvring avoided the 'white telephone poles', as the missiles were nicknamed by the Argentines.



A Dagger, possibly C-431 flown by Maffeis (see picture above), flies over* Sir Bedivere *during AZUL's attack. The flight was the first to hit the British that day, and escaped relatively unscathed.

Sea Harrier XZ457 wears three kill marks – Auld's two Daggers on 24 May and Morrell's A-4 on 21 May.

24 May 1982
ORO flight's disaster

Some time later, a flight from San Julian – ORO with Major Puga, Captain Diaz and Lieutenant Castillo – was heading towards San Carlos following the northern coast of West Falkland, in order to hide from radar. Before passing Pebble Island, the three Daggers were detected by the frigate HMS *Broadsword* which was acting as radar picket and advanced air defence ship (together with the Type 42 destroyer HMS *Coventry*). The ship's controller quickly vectored a Sea Harrier CAP from No. 800 Squadron, flown by Lieutenant Commander Auld in XZ457 and Lieutenant Smith in ZA193. The naval interceptors climbed to get a better view and to dive after the Daggers, gaining speed in the process and negating the Dagger's speed advantage; the Argentine fighter-bombers tried to escape, jettisoning their external stores, but the attack was very well planned. Auld launched his two AIM-9Ls one after the other. The first hit Puga's Dagger C-419, which exploded and fell into the water.

Major Puga was able to eject during the last seconds. "We were flying very low over the waves. We saw the Sea Harriers at the last moment and tried to evade them, but to no avail. I saw Castillo's aircraft blow up and at the same time felt a missile hitting my aircraft. I tried to gain some height, pulling back the stick, but the aircraft started to roll – flames were pouring from the cockpit backwards, then a wing folded. I ejected with a 90° bank angle, parallel to the surface of the water. I never lost consciousness and perfectly remember the jerk as the parachute opened. I was at first surprised to be alive, and thanked God for it. The parachute canopy was not completely deployed when I hit the water."

Puga's ordeal was not over: injured, he spent several hours in the cold water struggling to keep his head above the waves. He swam to Pebble Island and spent the night on a rocky beach, and was found the next day by an Argentine patrol led by a Marine lieutenant. On 29 May he, Raul Diaz, several other personnel and Lieutenant Volponi's body were picked up in a daring rescue operation led by Captain Uriona of Grupo 9 in a DHC-6 Twin Otter. Puga's wristwatch had stopped at 11.08, the time of his ejection. To this day he keeps it as a reminder of those dramatic hours.

Auld's second Sidewinder got Captain Diaz in C-430. He ejected and the Dagger fell in the water to the north of Pebble Island, close to where Puga's aircraft fell. Smith fired an AIM-9L at Castillo in C-410 in a textbook lock-on, hitting the Dagger, which, enveloped in flames, fell to the ground on the western side of Elephant Bay; the unfortunate Argentine pilot was killed. For a few seconds, both Sea Harriers pursued a fourth Dagger which they thought formed part of the same flight, but in fact it was No. 3 of PLATA flight, who made good his escape.

Grupo 6 de Caza had again suffered grevious losses from the deadly combination of Sea Harrier and AIM-9L Sidewinder. ORO flight had been completely wiped out, with little to show for it. Such a loss rate could not be supported for much longer, for the group would run out of aircraft, and possibly pilots. Six of the eight pilots downed by Sea Harriers during the Battle of San Carlos (21-27 May) had been saved thanks to the Martin-Baker Mk JM-6 zero-zero ejection seat.

On the left of this Grupo 6 trio is Teniente Carlos Julio Castillo, shot down on 24 May by Lieutenant Dave Smith during the complete destruction of ORO flight.

25-27 May 1982
San Carlos reflections

Over the following days the Daggers made very few sorties, partly due to bad weather and partly to a complete reorientation of Grupo 6's strategy. On 25 May two sections were launched from Río Grande at 11.00 and 11.02 – ÑANDU and FUEGO respectively – on an offensive reconnaissance mission over the southern side of the Falkland Sound, but they found nothing. Next day, a Dagger flight, LLAMA, dive-bombed through the cloud cover over British troop concentrations near Port San Carlos. No AA fire was spotted by the pilots, nor was anything achieved by the parachute-retarded bombs. On 27 May the beachhead was definitively consolidated and British troops advanced to other points.

This seven-day period (21-27 May) was later called the Battle of San Carlos. It was considered a victory for UK forces in spite of the courageous, but in some ways ineffective, efforts of the Argentine combat aircraft. Grupo 6 contributed a total of 47 escort/cover and attack sorties (21 from San Julian and 26 from Río Grande), losing nine aircraft and three pilots. Some Daggers had been hit by small arms fire or shrapnel and, although they returned home, they were temporarily out of service for repairs. In exchange, Grupo 6 achieved what could only be called meagre results.

On 28/29 May this Grupo 9 Twin Otter (T-82) made a daring flight into EAN Calderon, Pebble Island, to retrieve wounded and downed pilots, among them Grupo 6's Mayor Puga and Capitan Diaz. They had been shot down on 24 May by Andy Auld.

28 May 1982
Abortive mission

On 28 May, in an attempt to support the Argentine garrison at Goose Green and Darwin which was threatened by advancing British paras, the FAS planned 10 fragmentary orders, among them a Dagger flight. The mission was to attack advancing UK troops as well as the ships engaged in shore bombardment. Unfortunately for the Argentine ground forces, weather conditions were not favourable for conducting air operations: the islands were affected by a low-pressure area, producing rain and snow together with very low visibility. The four Daggers could not use their weapons and were forced to return home.

29 May 1982

Daggers return to 'Bomb Alley'

Next day the weather improved slightly and the FAS ordered that several flights be launched. The first to arrive at the operations area at 12.25 was LIMON section with Captain Mir Gonzalez and Lieutenant Bernhardt from Rio Grande. Both were tasked with offensive reconnaissance and loaded with three 500-lb parachute-retarded bombs. The pair arrived at San Carlos Water and did not find any shipping there or in the Sound, so the leader thought that it was better to save the bombs for another mission and return home. At that point, Mir Gonzalez discerned to the north, at extreme distance, the silhouette of a large ship. Seconds later Juan Domingo Bernhardt in C-436, who was some distance behind the leader, was shot out of the sky by a Rapier missile: the Argentine pilot and his Dagger plunged into San Carlos Water.

Almost two hours later, PUMA flight formed by two Daggers (the third had aborted) approached the Falkland Sound by the north of Pebble Island. To the south they found a Sea Harrier CAP and, believing that they were going to be intercepted, the Daggers jettisoned their stores and returned to San Julian. In fact, it was a No. 800 Squadron section which was attacking the airfield of Pebble Island, and the Sea Harrier pilots had not seen the Daggers.

Bernhardt was the fifth and last pilot lost by Grupo 6 de Caza during the conflict, and C-436 was the last Dagger lost. Such numbers of losses in about only nine days of effective fighting had a dramatic effect on the unit's personnel, especially considering the overall poor results obtained.

On 8 June HMS* Plymouth *was caught by Daggers in Falkland Sound.

4 June 1982

Close support missions

There followed several days in which weather conditions hindered the normal mission tasking. On 4 June the situation of the Argentine garrison in the Falklands was beginning to get desperate, and the FAS decided to launch several close support sorties. Low clouds (with a minimum ceiling of 150 ft/45 m and a maximum of 500 ft/150 m) and rain squalls made it impossible to undertake low-level attacks, so it was decided to make medium-level or dive-bombing attacks.

A sortie was planned for Escuadrón Aeromóvil Número 2, the pilots assigned being Comodoro (Colonel) Villar, Captain Demierre, and First Lieutenants Musso and Roman. Each Dagger carried two 500-lb parachute-retarded bombs. At 16.30 the four aircraft were over the target area near Mount Kent. They dropped their bombs in 60° dives among the clouds, although results were not observed, and all the Daggers returned home safely to San Julian.

5 June 1982

Recon

At 14.46 the next day, FIERRO section of Daggers arrived over the islands, armed only with 250 rounds of HEI for their 30-mm DEFA cannon per aircraft. They made a reconnaissance run the full length of the Falkland Sound without observing any British ships, and returned home unscathed. At 15.30 the three-Dagger NENE flight was over West Falkland, tasked to make an offensive reconnaissance of King George Bay from the south, inlet by inlet, creek by creek along its coast, unsuccessfully looking for a Type 42 destroyer presumably on radar picket duties.

8 June 1982

Plymouth attack

In a change from the cloudy or misty weather of past days, 8 June dawned with crystal-clear skies dotted with some clouds. In the FAS war room at Comodoro Rivadavia, messages had been pouring in since early morning from the islands: the British were establishing a new beachhead at Port Pleasant, about 27 km (17 miles) southwest of Port Stanley. Two amphibious ships in the bay were unloading supplies and equipment without haste, as in peacetime, and apparently without any defensive measures against possible air attacks. Brigadier General Crespo was perfectly aware of the carnage the Sea Harriers could inflict upon his fighter-bombers if they were not temporarily kept away from the Port Pleasant area. The fragmentary order was relatively simple and initially included Grupo 5, Grupo 6 and the Mirage IIIs from Grupo 8, which would perform decoy duties, simulating fighter-bomber flight profiles heading into San Carlos. A Dagger section was also tasked with this role.

The Grupo 6 attack mission was formed by six Daggers divided into two flights: PERRO with Captain Rodhe, First Lieutenant Gabari and First Lieutenant Ratti; GATO with Captain Cimatti, Major Martinez and First Lieutenant Antonietti. Both flights were launched at about 13.00 from Rio Grande, each aircraft carrying two 500-lb Mk 82s, full ammunition for the 30-mm guns and two 1700-litre (375-Imp gal) drop tanks. Just after take-off, Antonietti collided with a bird, causing some cracking to the windshield and forcing him to abort the mission. The five remaining fighters joined with a Learjet (coded TC-23) from Grupo 1 Aerofotografico (Photographic Group), which acted as a pathfinder. The small twin-jet, with state-of-the-art navigation systems, guided the Daggers near the southwest coast of West Falkland, from where they established a northeast heading towards Falkland Sound. The Daggers intended to turn east, crossing southern East Falkland and making the attack run on Port Pleasant from the west.

C-414 is seen at Rio Grande shortly after the* Plymouth *attack, wearing a victory symbol on its intake and armed with Mk 82 bombs. At the time Grupo 6 thought that they had sunk the ship.

The weather had worsened, bringing low clouds plus rain and snow squalls, causing the formation to deviate slightly from the planned route. Then at about 14.00, while flying across the Falkland Sound on a northeast heading, they had an enormous surprise: in their 10 o'clock position was the frigate HMS *Plymouth*. The ship was heading for the relative security of

Two of the five Daggers which attacked* Plymouth *are seen during the return flight to Rio Grande, photographed from the Grupo 1 Learjet which provided navigation for the mission.

San Carlos Water after a night spent in shore bombing duties. The Grupo 6 formation had been detected by the frigate. The Daggers made a wide turn on a northerly heading to position for the run, while the warship increased its speed in an attempt to reach the defences of San Carlos Water.

The Daggers attacked across the port side of the ship at an IAS of 550 kt (1015 km/h; 630 mph). Rodhe was on the right, Ratti at the centre and Gabari on the left; behind, in line abreast, were Cimatti and Martinez. Despite the 20-mm AA fire and a Sea Cat missile fired at them, the aircraft continued their run. The *Plymouth* was hit by 30-mm gunfire and five 500-lb bombs (of eight dropped).

Miraculously for the ship's crew, none of the five Mk 82s exploded, although a fire on the stern resulted from a 30-mm round setting off a depth charge. The subsequent flooding produced a 6° list.

Only one of the Daggers was damaged (lightly, due to flying shrapnel), and Ratti could not drop his bombs due to a generator failure. After the attack the Grupo 6 fighters turned on a southwesterly heading, and during the first leg were pursued (unsuccessfully) by a Sea Harrier CAP. On returning to Rio Grande, the five pilots were acclaimed as heroes, since at the time the Argentines believed that the frigate had been sunk, which was not the case.

Left: Viewed through a gunsight, a bomb is see landing perilously close to HMS* Plymouth. *Altogether five bombs hit the ship – mercifully, none exploded.

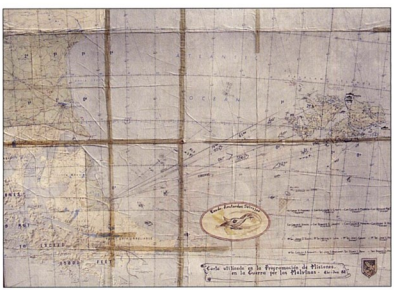
Below: With HMS* Avenger *in close attendance,* Plymouth *burns and lists 6° after a 30-mm round from a Dagger's cannon set off a depth charge on the stern.

13 June 1982

Last-ditch effort

On 13 June the situation was critical for the Argentine forces on the Falklands, for the British were advancing inexorably towards Port Stanley. In what became the last FAS daylight missions, it was intended to launch the maximum number of attack sorties against UK ground positions in order to buy time for the Argentine army. Relatively few FAS aircraft were 100 per cent combat capable due to technical problems caused by the harsh winter climate with a high humidity factor, battle damage and compulsory maintenance checks. The staff of Grupo 6 de Caza planned four missions, their last of the war. (Incidentally, Escuadrón Aeromóvil Número 2 had moved some days earlier to Rio Gallegos.)

The mission developed as follows: Fragmentary Order No. 1317 – a three-Dagger flight was launched at 11.10 with the task of



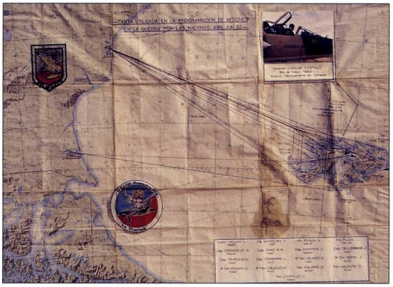
The Escuadrón Aeromóvil I briefing map from Rio Grande is also marked with the positions of the Dagger's main successes.

bombing British troop concentrations on the slopes of Mt Longdon. No. 3 had to abort since he could not retract the landing gear after take-off. When the two remaining Daggers reached the target area they were confronted with rain and heavy cloud cover. Through several holes in the clouds they detected a Sea King helicopter and a pair of Sea Harriers, then the GCI operator advised them that two blips were moving quickly towards them. Thinking they were in danger of being intercepted, the Dagger pair abandoned the attack and made good their escape without engaging the Sea Harriers.

Fragmentary Order No. 1318 – this flight of three Daggers was crewed by Captain Dimeglio, Lieutenant Aguirre Faget and First Lieutenant Roman. Prior to take-off from Rio Gallegos, Aguirre had to abandon due to brake failure. Both remaining pilots deviated from the planned route during their approach to the Falklands. They caught sight of a British helicopter 45 nm (83 km; 52 miles) south of the Falkland Sound: it was a Lynx HAS.Mk 2 (XZ233) from No. 815 Squadron, belonging to HMS *Cardiff*. Both Daggers attacked, knowing that the naval helicopter should have alerted all the AA defences. Dimeglio and Roman made several gun runs but to no avail. With a low fuel state, the frustrated Grupo 6 pilots had to return to Rio Gallegos.

Fragmentary Order No. 1323 – of the three-Dagger flight with callsign ZEUS, one of the aircraft had to abort for technical reasons. One of the other two had to turn back when about 60 nm (110 km; 70 miles) from the target due to oscillations above ~250/300 RPM in the Atar turbojet. The pilot was forced to fly over more than 450 miles (725 km) of frozen ocean with an engine which could have seized up at any moment; it was not a situation conducive to peace of mind. The remaining Dagger had to return some time later since a Sea Harrier CAP could had prevented him from reaching the target, and there was no wingman for support.

Fragmentary Order No. 1324 – comprised, as the others, of three Daggers, with the callsign VULCANO, this flight also had problems with the weather and a Sea Harrier CAP. They were forced to abandon the planned attack when the Sea Harriers went after them, for the Daggers were not configured for the air-to-air role. At about 16.40 the last VULCANO aircraft landed at Rio Gallegos.



This is the briefing map from San Julian. With its extra aft fuselage tank, the Dagger had enough fuel for a few minutes of combat over the islands, unlike the Mirage which was also forced to stay at altitude.

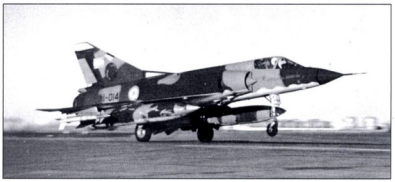
13 June 1982
Canberra escort

During the conflict's last period, Grupo 8's Mirages made a total of 15 air cover sorties over the Falklands without engaging in combat with the Sea Harriers. It is worthwhile to point out that the four cover/decoy sorties made on 8 June distracted the attention of the Sea Harrier CAPs, allowing the first Skyhawk and Dagger waves a relatively undisturbed run to their targets.

If there was one dramatic escort mission, it was that which took place on the night of 13 June, in what turned out to be the FAA's last combat mission of the war. About 19.00 on Sunday 13 June, the telephone rang at the Rio Gallegos air base command post. A pair of frag orders (1326 and 1327) was transmitted to prepare a strike sortie by a section of Canberras of Grupo 2 de Bombardeo to attack British positions on East Falkland and to prepare an escort section from Grupo 8 de Caza. Both twin-jet bombers had arrived earlier from Trelew naval air station so that they would have a shorter trip to the target.

The mission planning for the escort fighters was very complicated due to range considerations. It was necessary to precisely compute routes, rendezvous points and schedules so that the Mirages could protect the bombers from the Sea Harriers during the approach and attack phases of the mission. All the crews were at the briefing to establish the procedures to be followed. Soon afterwards, the Canberra section under the callsign BACO was launched. The first aircraft was crewed by Captain Pastran (pilot) and Captain Casado (navigator/bombardier) and the second by Lieutenant Rivollier (pilot) and First Lieutenant Anino (navigator/bombardier).

Fourteen minutes later the Mirage III section (callsign PLUTON) was launched, with leader Major Sánchez and wingman Captain Gonzalez. It was an extremely dark night with no moon, and at 5,000 ft (1525 m) there was a dense cloud cover which extended almost the whole distance to the islands. The two



When Mirages returned to the fray many were able to carry both R.530E and R.550 missiles, although there were few brushes with Sea Harriers.

A Mirage IIIEA with three missiles is pushed from its Rio Gallegos shelter. The small drop tanks signify a mainland defence mission.

A Mirage IIIEA with single R.530E missile prepares for a combat sortie from Río Gallegos. Facilities had to be hastily constructed to the aircraft and crews, and weather conditions at this bleak Patagonian airfield further hampered operations.

Mirage IIIs at once established their cruise altitude, beginning the crossing to the Falklands with navigation lights switched off and in complete radio silence. Due to the darkness, both interceptors were using a radar trail formation with the wingman keeping station with the leader using the Cyrano IIbis set.

Flying in complete radio silence, with the outside world in darkness and only the drone of the engines to hear, could create in less experienced pilots a feeling of vertigo, in which the aviator distrusts his flight instruments while at the same time his senses are leading him astray. However, both PLUTON 1 and his No. 2 were very experienced combat pilots. They were flying at 30,000 ft (9145 m) and as they approached the southern coast of West Falkland, the cloud cover was broken in several places. Through one of the holes they noted some brilliant flashes of variable intensity, a kind of storm, but it only occurred in one part of East Falkland and with a very regular rhythm.

On their Cyrano radars, the Mirage IIIs detected the Canberras 40,000 ft (12200 m) in front of them and near the target. Breaking radio silence, they established contact with the Falklands radar, and the controller confirmed that the flashes were artillery shells from British field and naval guns bombing Argentine positions around Port Stanley, although the shelling had so far not affected the radar's operational level. No Sea Harrier CAPs were in the area, so the Mirage pilots relaxed their vigil.

The Argentine radar guided the Canberras toward their objective. Soon, the first aircraft passed over the IP (initial point), closely followed by the second, and the bombs fell over the planned co-ordinates: British troop concentrations in an HQ area near Mt Kent. From the relative comfort of the fighter cockpit, Major Sánchez could perfectly discern the brilliant flashes caused by the exploding bombs, through some holes in the clouds.

Nearby he noted a missile being launched, which probably was defective since it began to make wild turns. That did not happen with subsequent launches; the British had fired four or five missiles at the same time, and they climbed almost vertically in a steady way. Major Sánchez called to Captain Gonzalez through the VHF radio warning him of the danger, although apparently the missiles were locked-on to the Canberra section, probably BACO 2. Lieutenant Rivollier, warned by radio of the situation, launched several flares and chaff bundles and initiated high-*g* evasive turns. He managed to avoid the missiles, which were lost into the dark night.

Sánchez's attention had been distracted by these events, but with his peripheral vision he noticed a new volley of missiles. They were at 12 o'clock, much lower but climbing very fast, and he could easily make out their bright red exhausts now that they were heading towards their targets. One of the missiles in particular grew bigger, seemingly locked-on to his Mirage. Sánchez was at 30,000 ft (9145 m) and a speed of Mach 0.92, executing a wide turn with the nose on a 45° heading. The missile was inside the turn but somewhat lower. Sánchez reduced engine power, tightening the turn, while at the same time commencing a deep spiral descent. His eyes were glued on the rapidly closing point of light, which was now at the centre of an imaginary circle drawn by the Mirage.

He noted that the flashes coming from Mount Kent and Port Stanley had finished, so sky and earth bled together in a frightening black velvet. It was very difficult to discern which way was up or down, and it was imperative to keep his eyes on the surrounding airspace and forget about flying by the instruments. Sánchez soon noted the first signs of vertigo as the Mirage's descending spiral continued, but then the missile exploded in an extremely bright fireball while red-hot shrapnel from the warhead pierced the night sky, leaving a tracery of red arcs. His Mirage had not been hit and the Argentine pilot sighed with relief, but not for long. A new and bigger missile – probably a Sea Dart – was climbing at a great speed, but, fortunately for Sánchez, it passed by his starboard side without exploding.

Temporarily out of danger, he risked a quick glance at the instruments and noted that the descent had brought him to a little below 15,000 ft (4575 m) and to the west of the planned course. He established contact with the FAA radar at Port Stanley, and the controller replied that both Mirages were on the screen but they were almost overflying Goose Green, and Captain Gonzalez was much lower, almost within the reach of AA artillery and Blowpipe or Stinger missiles. The Mirage section soon recovered its cruise height, at the same time trying to establish radio contact with the Canberras. The only reply came from BACO 2, who said that he himself had been trying to contact his leader, without success. A request was made to the radar controller and the dreaded reply came: any type of contact with BACO 1 had been lost. The Canberra (B-108) had been downed by a Sea Dart missile launched by the destroyer HMS *Exeter*. Its pilot, Captain Pastran, was able to eject, being captured by British troops, while the navigator, Captain Casado, fell to his death in the spinning Canberra which crashed into Mount Kent. The three remaining aircraft returned to the mainland, landing at Río Grande at 23.55.

Grupo 8 de Caza Mirage IIIEAs remained on alert at Río Gallegos for some time after the end of the war in case the conflict flared up again.

June 1982
The Mirage's war

Right: Almost identical to an earlier wartime photograph, these Mirages are seen manning the post-war detachment at Rio Gallegos. These continue to this day as a counter to the RAF presence in the Falklands.

This mission brought to an end the part played by Grupo 8 in the Falklands conflict. The unit made a total of 45 air cover and decoy missions over the islands and another 46 over the mainland and territorial waters (alert scrambles and patrols), losing two aircraft and a pilot in combat.

Despite the range problems (described previously) that prevented Grupo 8 from disputing air superiority with the Sea Harriers, their apparently poor results were criticised in some FAA circles. There was also a plan that the Mirage IIIs would have acted as back-up for the Daggers and Skyhawks had the conflict lasted longer. Nonetheless, their important contribution to the mainland air defence role can not be diminished.

After the war, Grupo 8 returned to its peacetime routine. Galloping economic crises in Argentina forced the implementation of drastic cuts in the air force. The number of flying hours allotted to the pilots diminished constantly, and in late 1984 reached a low of five hours per pilot per month. Detachments were and are made periodically to Rio Gallegos to exercise and provide supplementary air defence assets. As related earlier, in 1988 the Mirages were relocated to Grupo 6 de Caza, but continued with the same taskings.

In 1988 the surviving Mirage IIIs moved to Tandil, joining the Daggers in Grupo 6 de Caza. The Mirage remains Argentina's principal interceptor in the 1990s, although an upgrade programme or replacement is urgently required.

June 1982
Dagger round-up

A post-war photograph shows a Grupo 6 Dagger in a short-range attack configuration, with at least eight Mk 82 500-lb (227-kg) bombs and two inert Shafrir missiles.

VULCANO flight's abortive close support effort was the last combat sortie for Grupo 6 de Caza, ending its contribution to an air war which had not been particularly fulfilling from the Argentines' point of view, with only three ships seriously damaged (*Antrim*, *Ardent* and *Plymouth*). The poor results could be justified with the argument that the Dagger was not the right aircraft for these long-range anti-shipping sorties; the A-4 Skyhawk, in spite of being older, was better suited to this role thanks to its air-to-air capability.

First Lieutenant Jose Luis Gabari Zoco shares his thoughts about the last days of the war and after: "Because I was new to the Dagger and Grupo 6, during the height of the battle I was on operational training and ferrying replacement Daggers from Tandil to San Julian and Rio Grande. When I had 50 hours of Dagger time, on 1 June I reported for duty with Escuadrón Aeromóvil at Rio Grande. Once there I received several briefings on the war situation, Sea Harrier tactics, bombing profiles and ship recognition. The small Rio Grande base was overcrowded, housing Navy A-4Qs, Super Etendards, ancillary types from the latter

Surviving Daggers were modified to become Fingers after the war, the programme replacing the original avionics kit with that from the Kfir-C7. A Kfir-style nose with small strakes was added, this housing Elta EL-2001 ranging radar.

service and our Daggers. Also, the runway was shared for civilian use. The cold was intense and frozen mud was everywhere. The aircraft were dispersed in order to minimise the effects of a commando raid or air attack, and a pair of Shafrir-armed Daggers was kept on dawn-to-dusk readiness with the pilots and ground crews sheltered in a nearby hut. Quarters were clean and warm, although some pilots had to sleep in hotels in town.

"There was an atmosphere like in the old World War II movies. Air force, navy, army, coast guard and civilian aircrews (whose aircraft had been impressed by the FAA) met in the briefing room and the officers mess, to swap stories about flying and women. In spite of high losses, morale was high. Most of us thought that the war would continue for a month or perhaps two and so we would be killed. The possibility of conflict with the Chileans was high, as it was clear they had helped the British in some way, but we never thought about what would happen tomorrow.

"I only flew a couple of combat missions: on 8 June when we attacked the frigate *Plymouth*, and on 13 June. The next day (14 June) we did not fly since the weather over the mainland and islands was very bad. That evening we heard that Menendez (CO of Argentine forces in the Falklands) had surrendered, which shocked and demoralised us. Nonetheless, during several days following the surrender, we were at a state of high readiness just in case a higher authority ordered an all-out attack against British forces. That never came and towards the end of June most of us returned to Tandil [although a detachment was maintained at Río Gallegos for a few months]; the war was over, and we had lost five good friends."

From 1 May to 13 June, Grupo 6 de Caza flew a total of 133 combat sorties (the total planned was 160), 88 of which resulted in combat. The Dagger was the mainland-based combat aircraft which suffered most losses – 11 machines – with six pilots ejected and five killed.

1982-1983
Attrition replacement

Peru, in a rare act of South American solidarity, sold the FAA 10 Mirage 5Ps for $14 million, which covered most of the Dagger losses. These aircraft were delivered too late to participate in the conflict, but were active during the uneasy truce which followed the ceasefire, and were also on standby at Río Gallegos. Shortly afterwards, the aircraft were ferried to Río Cuarto maintenance centre to undergo modification to bring them to FAA standards (VHF radio, VOR, ILS, instruments, starting system, etc.). The Mirage 5Ps took the serial numbers of lost Daggers (C-403, 404, 407, 409, 410, 419, 428, 430, 433, 436), and served with Grupo 6 until 1987.

In addition to the 10 ex-Peruvian Mirage 5Ps received in 1982 and the two Mirage IIIDAs, the FAA acquired 19 Mirage IIICJs (C-701 to C-719) and three Mirage IIIBJs (C-720 to C-722) from surplus Israeli stocks for US$70 million. These aircraft had been re-engined during the early 1970s in Israel with the locally built Atar 9C. All had been given new spares and reskinned wings during their upgrades at IAI, and the troublesome Thomson-CSF Cyrano Ibis radar had been removed and replaced by a lightweight Elta ranging radar. They arrived in Argentina between December 1982 and February 1983, and were sent to the Río Cuarto overhaul and repair centre for conversion to FAA standards and a complete overhaul. The technicians there found them to be in good condition despite their age, the oldest having seen 20 years of heavy use.

Ex-Peruvian Mirage 5Ps replaced lost Daggers from June 1982, retaining the two-tone sand camouflage. They were later upgraded to Mara standard.

During late 1983, the first Mirage IIICJ/BJs were delivered to Grupo 4 de Caza of the IV Brigada Aérea, at El Plumerillo, Mendoza, which in turn handed its seven surviving A-4Cs to Grupo 5 de Caza of the V Brigada Aérea to augment its A-4Bs. The Mirages were and are still operated by the specially commissioned Escuadrón 55 (named for the 55 FAA personnel killed during the Falklands War).

On 19 March 1984, X Brigada Aérea was activated at Río Gallegos with Grupo 10 de Caza Martin Fierro, thus creating a permanent fighter presence at this Patagonian air base. Five Mirage IIICJs were delivered in that year to the unit, but were replaced by the Mirage 5Ps in 1987. By the late 1980s the 5Ps had been progressively upgraded with Argentine-developed avionics in a programme known as MARA. The Mirage IIICJ/BJs were then concentrated with Escuadrón 55 at El Plumerillo, Mendoza, which also acted as the Mirage OCU.

Twenty-two Israeli surplus Mirage IIIs were acquired in late 1982, this being one of the single-seat IIICJs. The aircraft have lightweight Israeli radar in place of the Cyrano unit.

Postscript

Rio Gallegos air base, 14 October 1982

"Four months had passed since the end of the conflict with Great Britain for the control of the Falkland Islands. I climbed down from a Grupo 9 Fokker F27 at Rio Gallegos. It was the southern hemisphere spring but, in spite of this, a chilly wind welcomed me once I was on the ground. I was an FAA guest and the base CO was expecting me. After a formal exchange of greetings and a welcome late lunch, I went to see the operational area and greet the people there.

"Rio Gallegos is a large and desolate air base and shares its installations with a civilian air terminal. It has few amenities, like the Patagonian region where it is located, and one feels a genuine frontier spirit there. The pick-up van with a grinning FAA NCO at the wheel took me over muddy perimeter roads until we arrived at the area where the hardened aircraft shelters are located. There I saw several Daggers and even a pair of ex-Peruvian Mirage 5s. I heard a far-off thunder and then a whistle; it sounded very familiar, like Atar turbojets. I raised my head and saw a pair of Daggers on the break, initiating the downwind leg.

"I meet the Grupo 6 detachment's CO, Major Carlos Napoleon 'Napo' Martinez, and we soon started to swap flying stories. He introduced me to several other Grupo 6 pilots. Talking with them, I heard in their voices the bitterness and frustration caused by the surrender and the heavy loss of comrades.

"I went inside a HAS where one of the Daggers rested, loaded with bombs on a centreline MER, while the trolley supported part of the bombs' weight. They were ready just in case the conflict flared up again. I looked closely at the Dagger, which had a white kill marking of a Royal Navy warship over its left intake. In some parts the paint was peeling off, revealing the lighter shades of its previous Israeli scheme. Suddenly, as if someone had shouted in my ear, I realised that it was a true war veteran of South Atlantic and Middle East conflicts. This aircraft had probably avoided MiGs, SAMs, AA fire and Sea Harriers, perhaps even downed one or more Soviet-made interceptors, and its bombs had pierced the thin alloy hulls of a Royal Navy warship. But it had survived, and was ready for another round if the humans needed its services. I touched the Dagger's cold aluminium skin, and I felt something very strange, as if the Dagger was a living being and wanted to tell me about its war adventures under two flags and half a world apart. This makes me sure that some aircraft have a soul within them."

Those are the words of Jesus Romero Briasco, at the time a Spanish air force Ala 11 Mirage III pilot. In October 1982 he went to Argentina on a short exchange tour with Grupo 8, and at the same time visited several FAA air bases, Rio Gallegos among them.

Salvador Mafé Huertas

Above: Spanish Mirage pilot Jesus Romero Briasco (centre) is seen with Falkland Mirage veterans Mayor Nene (left) and Capitan Testa (right) shortly after the war.

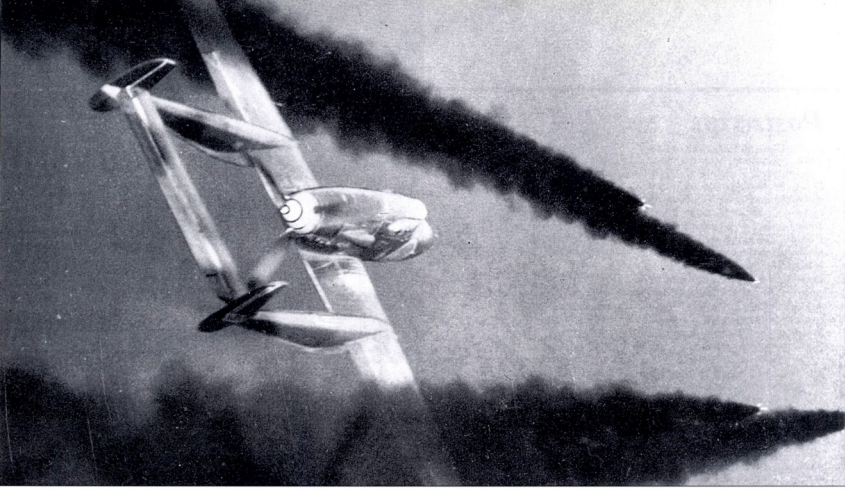
Right: The ex-Israeli Mirage IIIBJ/CJs were flown by Escuadrón 55, part of Grupo 4, until 1991.

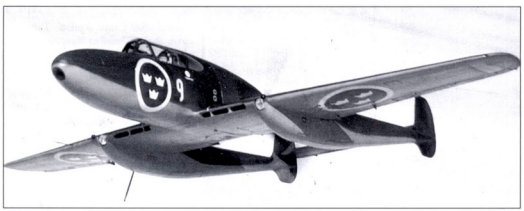
Summary of Mirage/Dagger losses during the Falklands War

Date	Aircraft	Location	Pilot	Shot down by
1 May	I-015	Pebble Island	Primer Teniente C. Perona (ejected)	Sea Harrier/AIM-9L (Flt Lt P.C. Barton, RAF)
1 May	I-019	nr Port Stanley	Capitan G.A. Garcia-Cuerva (killed)	Sea Harrier (damage)/35-mm AAA (Argentine)
1 May	C-433	Lively Island	Primer Teniente J.R. Ardiles (killed)	Sea Harrier/AIM-9L (Flt Lt R. Penfold, RAF)
21 May	C-428	San Carlos Water	Teniente P.I. Bean (killed)	Seawolf (Type 22, probably HMS *Broadsword*)
21 May	C-409	West Falkland	Primer Teniente H. Luna (ejected)	Sea Harrier/AIM-9L (Lt Cdr R.V. Frederiksen)
21 May	C-404	West Falkland	Mayor G. Justo Piuma (ejected)	Sea Harrier/AIM-9L (Lt S.R. Thomas)
21 May	C-403	West Falkland	Capitan G. Donadille (ejected)	Sea Harrier/AIM-9L (Lt S.R. Thomas)
21 May	C-407	West Falkland	Primer Teniente J.D. Senn (ejected)	Sea Harrier/AIM-9L (Lt Cdr N.D. Ward)
23 May	C-437	nr Pebble Island	Teniente H.R. Volponi (killed)	Sea Harrier/AIM-9L (Lt M. Hale)
24 May	C-419	nr Pebble Island	Mayor L.A. Puga (ejected)	Sea Harrier/AIM-9L (Lt Cdr A.D. Auld)
24 May	C-430	nr Pebble Island	Capitan R. Diaz (ejected)	Sea Harrier/AIM-9L (Lt Cdr A.D. Auld)
24 May	C-410	Pebble Island	Teniente C.J. Castillo (killed)	Sea Harrier/AIM-9L (Lt D.A. Smith)
29 May	C-436	San Carlos Water	Teniente J.D. Bernhardt (killed)	Rapier

Above: The Dagger still serves with Grupo 6, the 22 survivors grouped into II and III Escuadróns. All are now called Fingers, and have been repainted in all-over grey scheme.

Left: Mirage 5P Maras remain on Falklands alert at the Patagonian base of Rio Gallegos. They operate as the Escuadrón Cruz y Fiero (cross and iron – from an Argentine folk poem) as part of the X Brigada Aérea.





Above: An A 21-A3, from F6 Karlsborg Wing, lets fly with a salvo of 14.5-cm rockets. These unguided high-explosive rockets were carried in groups of four on underwing rails and were the primary armament of the ground attack-dedicated A 21s. This photograph was taken from an accompanying Saab B 18.

Left: This early-production J 21A displays the redesigned tail fins which were given a 'notched' lower leading edge compared to that of the prototype. F9 Wing, based at Säve, Gothenburg, was the first fighter unit to fly the J 21A.

Saab J 21

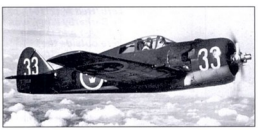
Sweden's Ingenious Fighter

The Saab J 21 established Sweden as an a country of innovative and resourceful aviation manufacture, and was the beginning of a line of world-beating indigenous combat aircraft designs – a line that is maintained to this day. The J 21 achieved many notable firsts, including being one of the very first production aircraft to be fitted with an ejection seat. It also achieved the more remarkable feat of undergoing (successful) conversion from a piston powerplant to a jet engine, resulting in the unique Saab J 21R.

When war came to Europe in 1939, Sweden found itself in a vulnerable position. It had long maintained a position of neutrality on the northern periphery of Europe. However, the rapid destruction of the Polish armed forces, its air force in particular, left the Swedes under no illusion that their own hopelessly outclassed air force would fare any better if Hitler's gaze turned to them. In 1939 Sweden had approximately 100 front-line aircraft, all of them obsolete, and only a single fighter wing. The Flygvapnet was not completely a paper tiger – during the winter of 1939/40 a voluntary 'wing' of Swedish aircraft (F19) was raised to help the Finns resist the invading Russians. Twelve Gloster Gladiators and four Hawker Harts (all wearing Finnish markings) with 230 ground personnel and 25 pilots were responsible for the air defence of half of Finland. Following the armistice of 30 March 1940, after combat operations from 12 January to 13 March, the unit was withdrawn, having served with distinction. In April 1940 Germany invaded Denmark, the Blitzkrieg rolled through Europe and the direct threat to Sweden became real.

Expansion and modernisation

The Flygvapnet embarked on a crash course of expansion, in which new bases were built and 13 combat wings funded. Orders had been placed for combat aircraft first with France, then Germany and finally the Netherlands – France, then Germany declined to make delivery and the Netherlands was invaded by Germany before the 18 Fokker G.1s purchased could be flown out. Sweden turned to the United States and ordered 100 Seversky P-35 (Republic EP-1) and 144 Vultee Vanguard fighters along with 50 Republic 2-PA dive-bombers. Only 60 EP-1s (known as J 9s in service) and two 2-PAs (B 6s) were ever delivered. The only other source of combat aircraft was Italy, so in 1940 Sweden purchased Fiat C.R.42 biplane fighters (J 11), Caproni Ca 313 light bombers (B 16/S 16) and, in 1941, Reggiane Re 2000 fighters (J 20). The



Above: The FFVS J 22 was a stop-gap fighter developed even more hurriedly than the J 21. Built largely from wood and steel, the first J 22 flew on 1 September 1942 and 198 were built. Some J 22s survived in use until 1952 but it was the first type to be replaced by the J 21.

Above: The novel tricycle undercarriage layout for the J 21 was trialled first on a large metal rig towed by automobile, and then on this modified Sk 14 (North American NA 14-3M). The Sk 14 undertook powered taxi and flight trials, in all weather conditions.

Above: The J 21 prototype (21001) is seen here on an early test flight. For the early portion of its flying career this aircraft operated in a natural metal finish with large national markings.

situation was ludicrous and makeshift. Not one of these aircraft offered a credible deterrent. The only answer was to build one in Sweden.

On 19 March 1941 (some would say quite late in the day) the Swedish Air Board (KFF) requested proposals for a new Swedish fighter. The delays were caused chiefly by the air force's previous subordination to the army and navy; the air force had been founded in 1926 from the air arms of those two services and still found itself dedicated almost entirely to answering their needs. As a result, virtually no money was ever spent on fighter development. This was ultimately to change.

Frid Wänstrom's unique design

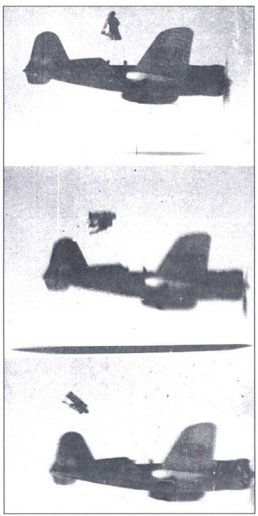
Twelve days from the KFF request, Svenska Aeroplan Aktiebolaget (better known today as Saab) submitted a design that was radical, to say the least. Mr Frid Wänstrom, the design team leader, envisaged a twin-boom aircraft, powered by a pusher engine with the pilot housed in a central nacelle. This configuration would concentrate the aircraft's weight on its centre of gravity and make it a stable gun platform, yet more manoeuvrable than a similar aircraft of conventional design. Armament would comprise two 12.7-mm machine-guns (later changed to 13.2-mm) in the booms coupled with two more guns and a single 20-mm cannon in the nose. The J 21 would also be the first Swedish aircraft to feature a nosewheel, which Saab hoped would make the aircraft incapable of ground looping. The design was almost unprecedented and some official reservations were expressed, but the Air Board gave Saab the go-ahead on 5 April. The new aircraft gained the designation L 21 (L for Linköping, Saab's home). Wänstrom and his team had planned to use the 793-kW (1065-hp) Pratt & Whitney Twin Wasp radial engine, built under licence in Sweden by Flygmotor AB.

Before a decision could be made the Air Board decided that the J 21 was too risky and cancelled the project in favour of the less adventurous (but equally unavailable) Saab J 23. Several objections were raised: how would the engine be cooled on the ground with no propeller wash to rely on, how would the pilot escape over the rear propeller if he had to abandon the aircraft, would the nosewheel work on Sweden's grass airfields, and would the aircraft be controllable on the ground with the rudders outside the propeller slipstream? Remarkably, Saab managed to convince the KFF of the J 21's merits and eventually it was allowed to proceed again. A mock-up was completed by 8 July 1941.

A German engine

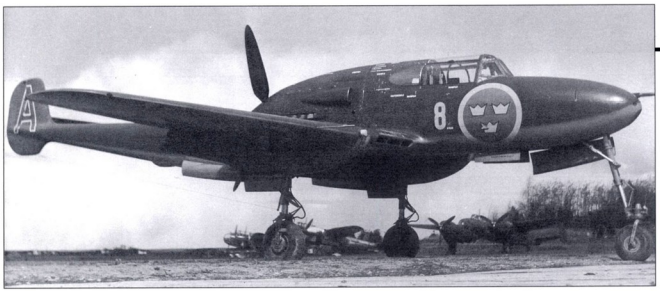
However, it soon became clear that the big fighter would need a more powerful engine than the Twin Wasp. Sweden had managed to maintain cordial relations with the Allies and the Nazis. This strange state of affairs allowed Sweden to apply to the Reichluftfahrtministerium for the supply of Daimler Benz DB 605 engines and a licence to build them in Sweden. Detail design of the prototype then began, in December 1941, with the DB 605 as its powerplant, but engine performance data was not released to Sweden until January 1942 and the first example engines were not delivered until June. The German authorities were obviously unwilling to hand over the engines. When the first examples did arrive in Sweden, Saab engineers found they had, in any case, been sabotaged by the slave labourers used to assemble them: they put sand in the cylinder bores, obviously believing the engines were intended for the German war machine. Finally, a licence-production deal was struck allowing Sweden to use the 1,475-hp (1098-kW) DB 605B.

Early wind-tunnel test utilised two models, of 1:10 and 1:4.5 scale. Both had electric motors installed to simulate the rear-mounted props. The J 21 wing was specially developed by the Swedish Aeronautical Research Establishment and the Royal Institute of Technology. Its maximum thickness was at 45° chord, reducing drag and maintaining laminar airflow over the



Above: This remarkable set of photographs, of the first recorded ejection, is taken from the ciné film shot by Saab on 8 January 1942. Airborne trials of the Mk 1 seat were made from this Saab B 17 – using a wooden dummy.

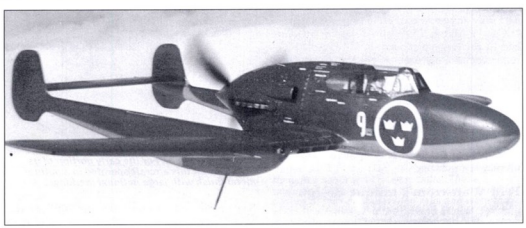
Right: Nose art, indeed any form of unit marking beyond the occasional wing badge, has always been rare on Flygvapnet aircraft. However, this aircraft from the second squadron (2 Divisionen) of F9 is wearing the squadron's 'Bonzo' badge.



Left: 'Red A' (21104), of F8 Barkarby Wing, was a J 21A-1 and is seen here outside the Linköping factory in 1946. The aircraft in the background are Saab B 18B bombers. The B 18B first flew in June 1944 and was one of the fastest piston-engined aircraft in service, with a top speed of 570 km/h (354 mph).

Below: Note the engine cooling scoop visible on this J 21A. This was fitted to the starboard side of each aircraft.

Above: Pictured in September 1949, pilots from F6 Wing discuss another mission. The J 21's 20-mm cannon was flanked by two machine-guns in the nose, with the gun camera housing below.



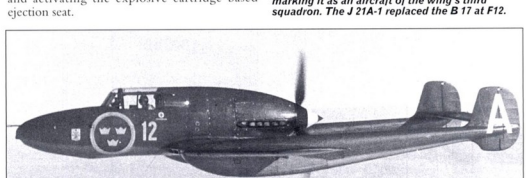
wing at high speed. Early flight tests showed that the wing design produced a top speed 25 km/h (15.5 mph) faster than that guaranteed by Saab. These initial tests vindicated the J 21's aerodynamic configuration with surprisingly little complication.

Ejection seat innovation

To overcome the serious question of how the pilot would escape the J 21 without being caught by the propeller, Saab developed its own ejection seat – almost a unique item at the time. Several alternatives were studied, such as blowing off the props, or even the entire engine, to allow a safe bale-out, or 'throwing' the pilot out of the cockpit on a flexible, extending boom. The debate over who was the first to provide a successful, working ejection system has raged for nearly as long as aviators and manufacturers recognised the need for such an escape system in high-performance aircraft. During those wartime years, Germany and Sweden were the acknowledged leaders in this field with the USA and UK lagging far behind. The first aircraft to fly with an ejection seat fitted was the Heinkel He 280. On 13 January 1942, Heinkel test pilot Schenk became the first person to call on an ejection seat for real when he was forced to escape from his He 280 after its controls iced up. By that time, Saab's plans to integrate an ejection seat in the J 21 were far advanced. Studies which had begun in 1940 culminated in the first trials with a dummy from a specially-modified Saab B 17 on 8 January 1942. The prototype J 21 first flew with the seat installed on 30 July 1943, but delays to the J 21 meant that a plethora of German combat aircraft entered service with (largely retrofitted) ejection seats, well before the J 21. The first recorded use of such a seat, in combat, was by both crew of a He 219 on 11 April 1944. It took another two years for a J 21 pilot to follow this least-favoured of leads. All early systems were cumbersome and unreliable. In the J 21 the pilot had to manually jettison the canopy before 'adopting the position', pushing the stick away and activating the explosive cartridge-based ejection seat.

Another unique feature of the J 21, the nose-wheel, caused early problems when trials revealed a tendency to shimmy. The new tricycle undercarriage was built into a test rig which was then towed behind a car, and this revealed the gear's tendency to oscillate. This flaw was solved by fitting a Swedish air force North American NA-14 (Sk 14) with the J 21's tricycle gear and engaging in extensive powered taxiing trials. It also provided useful practice for future 21 pilots. Perhaps the biggest headache for the designers was providing adequate cooling for the engines on the ground, as originally feared by the Air Board. The first prototype was fitted with a hydraulic fan, which was later replaced by a mechanically-driven fan. The fans rotated at 13,500 rpm when engine rpm was at 1,800 rpm (ground idle) but were disconnected in flight. In the light of earlier troubles, it came as a pleasant surprise when expected vibration

Below: Kalmar-based F12 was the third Flygvapnet wing to transition to the J 21A. This aircraft, 'yellow A', also has a yellow spinner marking it as an aircraft of the wing's third squadron. The J 21A-1 replaced the B 17 at F12.



Twin-tailed fighters
During the lifespan of the J 21A there were few twin-tailed prop-driven fighters. The most well-known are the Lockheed P-38, Northrop P-61 and Focke-Wulf Fw 189. Added to these were the unsuccessful Savoia-Marchetti S.M.91 (also DB 605-powered), Nakajima Ki-98, Fokker D.XXIII (destroyed by the advancing Germans in 1940) and Vultee XP-54 'Swoose Goose', which most closely resembled the J 21.

Ejection seat
The J 21A's Swedish-designed and -built Mk 1 ejection seat was the one item of equipment that set it ahead of all contemporary Allied fighters. The seat was safe and reliable. For ground testing, an aircraft was positioned between two tall wooden poles and the seat fired while attached to an inertia reel at the top of the poles (thus preventing it from dropping back down again).

Saab J 21A-1 F9 Wing, Säve, Gothenburg Sweden

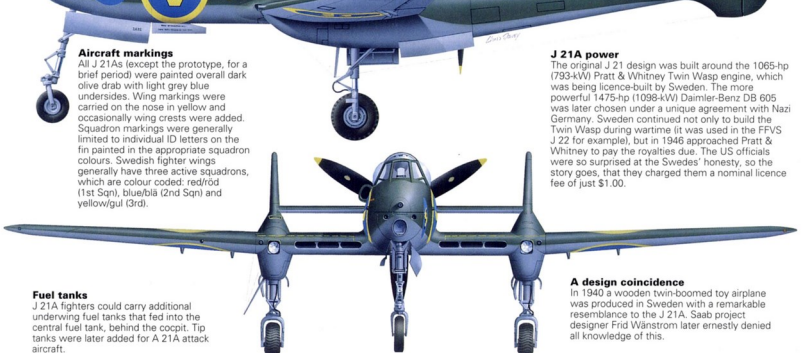
To its pilots the J 21A was the *tvestjarten* (earwig), on account of its twin-tailed configuration. Few successful twin-tailed fighters ever emerged from the piston era, and the J 21 is all the more remarkable when one takes into account the state of the Swedish aviation industry at that time. This aircraft, 'blå F'/'blue F' (21120) was delivered to 2 Divisionen, F9 Wing in June 1946. The J 21A remained in service only until 1950.

JATO for the A 21
To improve take-off performance when fully armed, the A 21A-3 attack variant could be fitted with jettisonable JATO bottles on bolt-on frames under the tailboom, near the fin.

Individual aircraft markings
This particular F9 aircraft, 'blå Filip', carried the 'Bonzo' dog badge of the wing's second squadron, soon after the unit transitioned to the J 21A. However, this badge was not applied across the rest of the squadron's aircraft.

Aircraft markings
All J 21As (except the prototype, for a brief period) were painted overall dark olive drab with light grey blue undersides. Wing markings were carried on the nose in yellow and occasionally wing crests were added. Squadron markings were generally limited to individual ID letters on the fin painted in the appropriate squadron colours. Swedish fighter wings generally have three active squadrons, which are colour coded: red/röd (1st Sqn), blue/blå (2nd Sqn) and yellow/gul (3rd).

J 21A power
The original J 21 design was built around the 1065-hp (793-kW) Pratt & Whitney Twin Wasp engine, which was being licence-built by Sweden. The more powerful 1475-hp (1098-kW) Daimler-Benz DB 605 was later chosen under a unique agreement with Nazi Germany. Sweden continued not only to build the Twin Wasp during wartime (it was used in the FFVS J 22 for example), but in 1946 approached Pratt & Whitney to pay the royalties due. The US officials were so surprised at the Swedes' honesty, so the story goes, that they charged them a nominal licence fee of just $1.00.

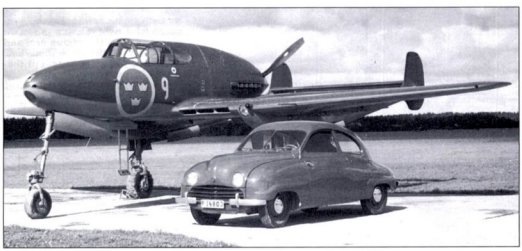


Fuel tanks
J 21A fighters could carry additional underwing fuel tanks that fed into the central fuel tank, behind the cockpit. Tip tanks were later added for A 21A attack aircraft.

A design coincidence
In 1940 a wooden twin-boomed toy airplane was produced in Sweden with a remarkable resemblance to the J 21A. Saab project designer Frid Wänstrom later ernestly denied all knowledge of this.

Left: This DB 605B-powered J 21A-2, 'röd C', was delivered to F15 in 1947, before being transferred to F12 in 1953. It served there only briefly before being replaced by the Saab J 29 'Flying Barrel'.

Right: Individual markings on Flygvapnet aircraft as elaborate as this sharkmouth were rare indeed. This is the second prototype J 21A 'röd A' (21002) which was transferred to F8 Wing, based at Barkarby, for evaluation in 1945. The sharkmouth was worn for a brief period only.



Above: Even to this day Saab advertises cars with aircraft and now has the Saab 900/9000 matched with the JAS 39 Gripen. This is a late 1940s photograph of the classic Saab 92 Sedan alongside a J 21A – the Saab 92 was Saab's first automobile design.

problems caused by the proximity of the propeller to the tailbooms did not materialise.

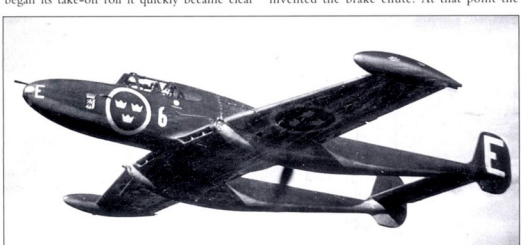
A remarkable maiden flight

The first flight of the J 21 was scheduled for 13 July 1943, at Saab's Linköping airfield. The unpainted prototype was to be flown by Saab's chief test pilot Claes Smith. Ground-running was to be kept to a minimum and no taxiing was allowed, to avoid overheating. Smith had earlier expressed some reservations about the aerodynamicists' unorthodox decree that take-off should be accomplished with full flap – a result of their wind tunnel findings. Smith's reservations soon proved to be well-founded. As the J 21 began its take-off roll it quickly became clear that the aircraft was not accelerating sufficiently and was rapidly using up Linköping's short grass runway. As Wänstrom and his team watched in horror, the J 21 prototype approached the end of the runway still wedded to the ground. At the end of the runway was a fence and a ditch. The J 21 tore through the fence and hit the bank of the ditch. This flung it into the air where, amazingly, it stayed. Smith had invented the ski jump! The J 21 appeared undamaged and, with gear retracted, the pilot conducted his elementary flight tests before electing to land at the nearby air force base of Malmen, which had a longer runway. On touchdown, however, Smith discovered his brakes had been damaged by the rough departure from Linköping and a second crash seemed imminent. At that moment, he remembered the prototype had an anti-spin parachute fitted to the rear fuselage. This he streamed immediately, keeping the aircraft straight on the runway. Smith had also invented the brake chute! At that point the J 21's main undercarriage collapsed, bringing the prototype firmly to a halt. The ignominious postscript to the first flight came when Smith had to suffer a lecture from the Flygvapnet C-in-C, General Bengt Nordenskiöld, who berated his 'absentmindedness' for taking-off with full flap.

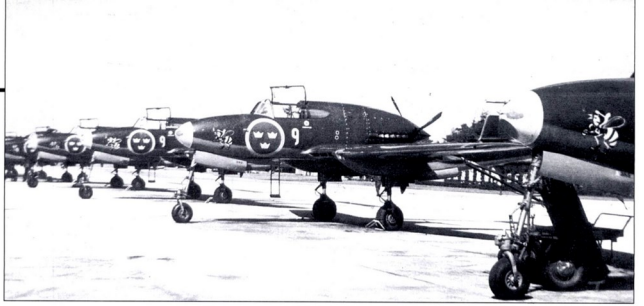
Quickly repaired, J 21 flight testing was moved to Sätenäs air base, home of F7 Wing, in western Sweden. Only a few DB 605 engines were ever delivered from Germany and they were fitted to the prototypes and initial production aircraft, designated J 21A-1. Swedish-built engines soon began to roll off the Svenska Flygmotor's (today Volvo Aero) production line at Trollhättan. Aircraft powered by the SFA-built DB 605Bs were designated J 21A-2s. It was anticipated that production deliveries would begin on 1 June 1944 but teething troubles delayed this into late 1945. The first J 21A-1s were delivered, on 1 December 1945, to F8 Wing based at Barkarby, Stockholm, for trials and conversion training. The first operational unit, with J 21A-2s, was F9 Wing, at Säve, Gothenburg. At F9, the J 21 replaced the FFV-built J 22 – a fighter that had been even more hastily built as an emergency stop-gap during the war years in Sweden.

Flying the J 21

Once in the hands of the Flygvapnet the J 21 became a popular aircraft to fly. Pilots liked the good view from the cockpit, its nosewheel steering, concentrated firepower and the type's good handling and flight performance. In April 1945 Sweden had managed to acquire P-51D Mustangs from the United States (on account of the J 21's delayed delivery), which were introduced into service as the J 25. There was little doubt that the J 25 had a more powerful engine and more sophisticated aerodynamics, but the margin between it and the J 21 was remarkably small. In experienced hands, a J 21 with its superior pilot visibility and firepower could reliably be expected to beat the Mustang. J 21 pilots also developed their own tactics to beat opposing fighters. One of the J 21's greatest strengths was its reluctance to stall, so its pilots would force opposing fighters into a climb, wait for them to stall out underneath the J 21, then pull out of the climb and dive on the stricken opponent. The J 21's controls were, however, always 'heavy' and it was hard work to fly the



The A 21A-3 attack variant was instantly recognisable by virtue of its tip-tanks – a design feature that was retained in the J 21R attack aircraft. The A 21's low-level handling qualities made it a good attack platform and the A 21A-3 was cleared to fly with 50-kg, 250-kg and 500-kg bombs, 14.5-cm and 18-cm rockets and even napalm tanks.



Right: Giving the lie to the notion that all J 21s were drab is this line-up of J 21As from the second squadron of F9. The badge comprises a black and yellow wasp with flying helmet, boxing gloves and bolts of lightning in place of antennae.

Below: From a total production of 297 piston-powered J21As, only two survive today – as part of the Swedish air force museum at Malmen. This excellent museum also boasts a J 21R.

aircraft in air combat. Rear visibility from the cockpit was poor so J 21 units routinely flew paired 'fluid four' formations to provide maximum mutual cover. Formation flying was complicated by the restricted view from the cockpit and formation keeping at altitude was hindered by the slow response of the radiator flap system. Above 18,000 ft (5486 m), performance became sluggish and the J 21 had a tendency to pitch down when it approached its critical Mach number, often coupled with aileron flutter. The problem of cooling for the engine was never wholly solved. The J 21 was seen as a demanding aircraft to fly, but not an impossible one. Pilots reckoned they could beat all-comers and were proud of their Swedish-designed mounts. In particular, the ejection seat system gave them an advantage enjoyed by few other combat pilots, and Flygvapnet flyers had complete confidence in it.

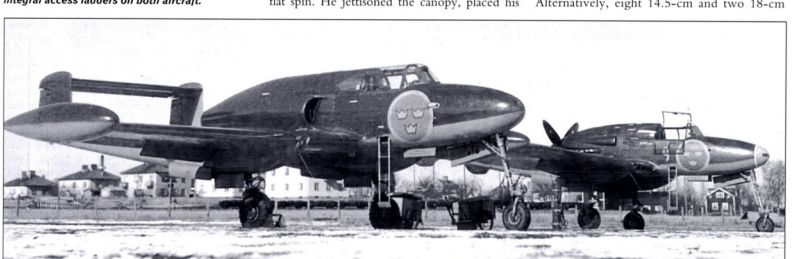
Below: Side-by-side with an A 21A-3, this view of an early J 21R gives some impression of the changes to the airframe needed to accommodate the girth of the Goblin turbojet. Note the neat integral access ladders on both aircraft.

First ejection

On 29 July 1946 Lieutenant Bengt Johansson (who later changed his name to Järkenstedt) became the first Swedish pilot to eject from an aircraft. On that day Lieutenant Johansson was flying his J 21A-1 from Säve, with 2 Divisionen (squadron) of F9 Wing. The J 21s of his squadron were practising naval gunnery attacks opposed by the J 22s of the wing's other squadrons. Climbing out from a gun run, Johansson's J 21 collided with a pursuing J 22 which tore away one of the J 21's twin tails. Johansson lost control as his aircraft entered a flat spin. He jettisoned the canopy, placed his feet in the stirrups and ejected, safely. The J 22 that had hit him lost half its starboard wing and its pilot was also forced to bail out. Both men parachuted into the sea but Johansson was treated to the added hazard of being buzzed by his wingmates – one in particular insisted on making alarmingly close passes to record the event on his gun cameras. (To add insult to injury, when Johansson later accused him of attempted murder the offending pilot admitted he had no film left!) Johansson was quickly rescued by a Swedish navy destroyer and two days later was back flying with his squadron. At the time the Swedish press reported this event as a unique one, a 'first' in aviation history. German experiences during the war were not widely known then, but Johansson's escape is certainly one of the best documented of early ejections and a tribute to the efficacy of the Swedish system.

A 21 attack variant

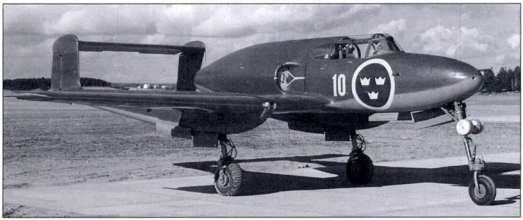
The J 21 was designed from the outset to be a potent gun platform, and here the designers excelled. At a range of 450 m (1475 ft), the spread of fire from the nose guns was less than 0.6 m (2 ft). The machine-guns in the booms had a spread of just 2 m (6.5 ft) at 220 m (720 ft). The J 21A-2 was fitted with a 20-mm Bofors cannon instead of the A-1's Hispano cannon. Both carried the same 13.2-mm Browning machine-guns. The J 21's excellence as a gun platform led to the development of a ground attack version, the A 21A-3 (also referred to as the J 21A-3 and B 21A-3). While the A 21 retained all the gun armament of the J 21, 250-kg, 500-kg, or 600-kg bombs could be carried under the inner wing hardpoints with up to four 50-kg bombs under the outer wing stations. Alternatively, eight 14.5-cm and two 18-cm



Left: This aircraft (21119) was the first of the four J 21R conversions and made its maiden flight on 10 March 1947. It was destroyed in a mid-air explosion on 22 September 1947. The second prototype flew in March 1949.

Below: The sole operational J 21R wing was F 10, based at Angelholm. This pristine example was one of the first batch of the new jet-engined Saabs to be delivered to the unit in January 1950.

Above: This photograph of the first J 21R clearly shows how the Goblin 2 engine (Swedish designation RM 1) has been grafted to the back of a standard J 21A. The jet-powered J 21R was a remarkable achievement, but lacked performance.



Left: Early developmental flying with the J 21R was conducted in typical Swedish winter conditions. For any Flygvapnet combat aircraft to be effective it must be capable of functioning in the worst winter weather.

rockets could be carried. A Saab BT9 toss-bombing 'computer' and weapons sight was also fitted. The A 21 had wingtip tanks that each held 400 litres (90 Imp gal) of additional fuel. In total, 297 A/J 21s were built by Saab at Trollhättan, when production ceased in 1948. Excluding the three prototypes (one of which was a non-flying fatigue test frame), they numbered 54 J 21A-1s, 124 J 21A-2s and 119 A 21A-3s.

Operational career

The piston-engined J 21 was operational with five Swedish fighter wings. At F9, based at Säve, Gothenburg, the J 21A-1 replaced J 22s and remained in service until replaced by J 28s in 1950. Next came F15, based at Söderhamn, where the J 21A-1 served from 1946 to 1953 until replaced by J 28s. The third wing was F12, based at Kalmar, which exchanged its Saab B17s for J 21A-1s in 1947. They served until the arrival of J 29 Tunnens in 1952/53. F6, based at Karlsborg, flew A 21A-3s from 1949 until 1953 when they were replaced by A 29B Tunnens. Finally, F7, based at Såtenäs, operated the A 21A-3 from 1947 to 1951 when they were supplanted by the A 21R. Saab proposed a re-engined version of the J 21, the J 21B, which was to have been fitted with a Rolls-Royce Griffon piston engine, a pressurised cockpit and bubble canopy. This would have transformed the J 21 into a world-beating fighter had it not been for one thing – the arrival of the jet age.

Like the J 21A before it, the Saab J 21R saw out its operational career as an attack aircraft. Like the A21A-3, the A21R was fitted with wingtip fuel tanks to compensate for the high fuel burn of its low-level mission.

As Sweden was introducing the first of its J 21s, of which it was justifiably proud, the type had already been made obsolete by the jet-powered warplanes introduced by the Allied and Axis powers. Sweden's excellent relations with the UK allowed it to become an early customer for the de Havilland Vampire (Swedish designation J 28). Anticipating this, in 1945 Saab proposed a radical modification of the J 21 which would propel the Flygvapnet (and the Swedish aviation industry) into a new era. Saab took the Vampire's de Havilland Goblin turbojet engine and fitted it to the J 21. Some sources have suggested that this was a remarkably easy process, which is not quite the case. Saab hoped to be able to retain 80 per cent airframe commonality with the J 21A but, in the event, only achieved 50 per cent. The 'new' aircraft became known as the J 21R ('R' for reaction/jet) and featured several obvious changes to its propeller-powered predecessor.

J 21R – Sweden's first jet

The tail was strengthened and the elevator unit raised above the jet efflux. The aerodynamic profile of the wing was adapted and the wing extended. The canopy was streamlined and many of the fuselage access panels were strengthened to cope with the higher flying speeds. Additional space had to be found in the fuselage to cope with the demands of the very thirsty Goblin jet engine, and the engines themselves had to be improved to cope with operations in Sweden's Arctic conditions. Two large air intakes were added to the fuselage sides to feed the Goblin. The undercarriage was repositioned slightly, as were the airbrakes, and the cockpit was completely redesigned. New instruments, gunsights, radios and oxygen equipment were fitted.

Four J 21R prototypes (all converted J 21A-1s) were built and the first of these took to the air

Saab J21RA F10 Wing, Ängelholm Sweden

F9 'Skanska Flygflottilj' was the sole Flygvapnet operator of the J 21R fighter, which had a brief operational career from 1949/50 to 1951, when the aircraft were transferred to F7 as A 21Rs. During their time in service, F10's J 21Rs carried few markings, not even squadron codes. Today F10 is the last Flygvapnet J 35 Draken operator and will be one of the first wings to convert to the JAS 39 Gripen, after F7.

J 21R maneouvrability
While the J 21R was not an exceptional performer, it never lost some of the characteristics that made the J 21A a popular pilot's aircraft. Chief among these was its tight turning circle, which led one ex-pilot, Bo Hagelborg of F10, to remark "the J 21R could almost bite itself in the tail."

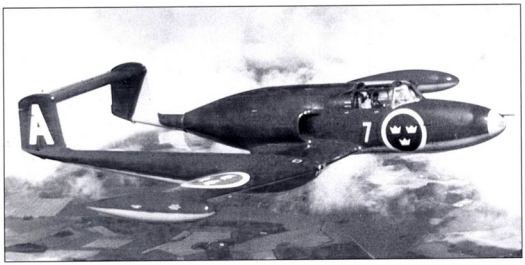
The J 21R and the jet era
Sweden's J 21R was a remarkable achievement – when it first flew, jet technology was only being seriously developed by the UK, USSR and the USA. The fact that the J 21R was allowed to use a British jet engine is a measure of Sweden's post-war standing with Britain, but the huge advances in aerodynamics, in the few years since the J 21R's basic airframe had been designed, meant that the aircraft was only ever a stepping stone.

Swedish jet genus
Even as the J 21R was being delivered to the air force, aircraft were being abandoned on the production line. In 1945 Saab had begun work on its next jet, the swept-wing J 29 which first flew on 1 September 1948. Saab engineers had gathered German wind tunnel research material through Switzerland, where it had been over-looked by US intelligence. Saab's J 29 was Europe's first post-war swept-wing fighter.

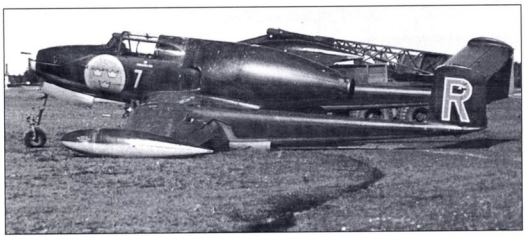
Jet J 21 operators
The J 21R's brief front-line career saw it grace the flight lines of very few units. The fighter J 21Rs served with F10 alone and the attack A 21Rs served chiefly with F7. At the end of their useful lives about 10 aircraft were passed onto F17, at Kallinge, from F7. They were used to give some limited jet flying experience to the pilots of F17 then preparing to transition from the Saab B 18 bomber to the Saab A 32A Lansen.

Above: This F6 Wing A 21A-3, 'gul E' (21297), was handed over to the third squadron of F6 in November 1947. It is seen here carrying a 250-kg bomb on a centreline pylon. Repetition of the squadron code-letter on the nose was a feature seemingly unique to the A 21A. F6 transitioned to A 29Bs in 1953, but the wing was disbanded (as a Viggen operator) in 1993.

Right: A closer view of the squadron markings briefly carried by 3 Divisionen, F9 Wing. The Red Cross marking under the canopy rail highlights the storage point for emergency first-aid supplies.



Above: F7 has always been the Flygvapnet's premier attack wing and so it was natural choice to adopt the A 21A in 1951. Two different aircraft (21428/29) carried 'blå A' markings during F7's A 21R era – 21429 was lost in a crash in June 1951.



Below: This aircraft, 'blå R' of F7, is seen after a gear collapse incident in September 1952. The J 21's undercarriage never gained a reputation for sturdiness and this, coupled with early pilot jet inexperience, led to some mishaps.

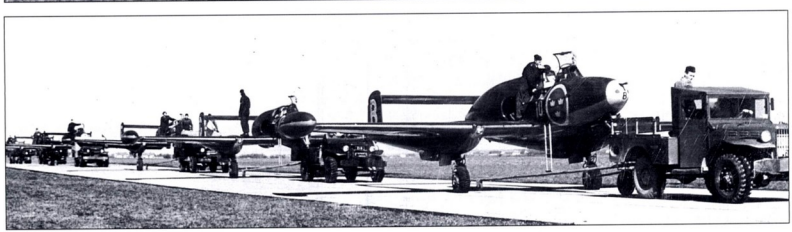
on 10 March 1947. The pilot for this maiden flight was Åke Sundèn. The project was under the direction of Ragnar Härdmark, who had made the J 21 a reality within a year of commencing design work.

The J 21R was well liked by those who flew it, including pilots from abroad. Rate of climb was likened to that of the P-38 Lightning, but at the time all specific performance details were highly classified in Sweden. Handling was never exceptional, but the J 21R retained the J 21A's tight turning circle and its aversion to stalling. The J 21R's maximum speed at altitude was 800 km/h (500 mph), its service ceiling was 12000 m (39,379 ft) and its climb time to 5000 m (16,400 ft) altitude was 6.8 minutes. Its range with external tanks was 1360 km (845 miles), take-off distance (to 15-m/50-ft altitude) was 840 m (2,750 ft) and landing distance 750 m (2,460 ft).

However, as a fighter the J 21R lagged behind aircraft in service elsewhere. Its performance at altitude was, frankly, poor, and the air force had to develop simple hit-and-run tactics to get the best from the J 21R. Only a single fighter wing, F10 at Ängelholm, in southern Sweden, was initially equipped with the type. Deliveries began in August 1949, but by spring of 1950 these aircraft had been transferred to the attack wing F7. Series production was cut from 120 to 64. Of the 60 production J 21Rs that did see service, 34 were the J 21RA variant powered by the 13.1-kN (2,945-lb) Goblin 2 (Swedish designation RM 1) and 30 were J 21RBs powered by Swedish-built 14.7-kN (3,305-lb) Goblin 3s (RM 1A).

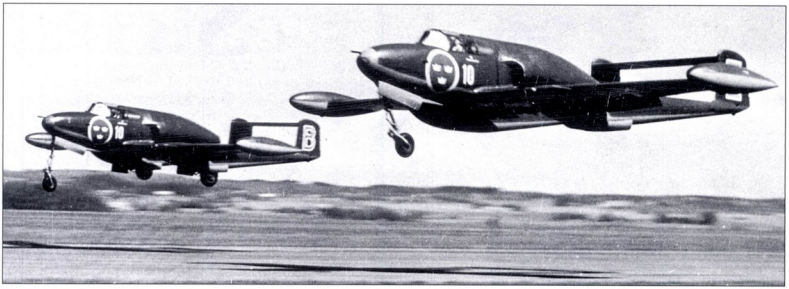
A 21R – jet attacker

The J 21R was virtually obsolete from the outset and an entire batch of components, enough to equip a wing with fighters, was scrapped. Already Saab had the swept-wing J 29 Tunnen, the famous 'flying barrel', which was a generation or more ahead of the J 21R. The J 21R thus became the A 21R as it was relegated to a ground-attack role. It provided valuable jet experience to the pilots of F7 who developed



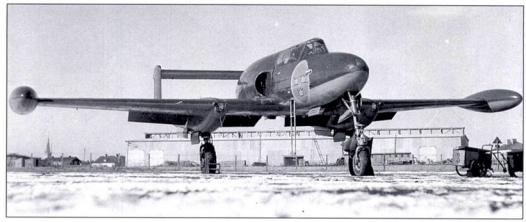
Below: This line-up of F9 Wing J 21Rs is seen during operations from their home base of Angelholm. Note the repeated squadron codes on the (yellow) noses and the unusual split tow bars attached to the main gear.

The ventral gunpack developed for the A 21R housed eight machine-guns arranged in spaced pairs. The sharkmouth seen here on this F7 aircraft was painted for an exercise.



Above: A pairs take-off by two A 21Rs from Angelholm. The A 21R had a typical endurance of about one hour, but with careful fuel management and high-altitude cruising this could be stretched to over two hours – an interesting, if not very practical, demonstration.

Right: In place of bombs, or the ventral gunpack, the A 21R could carry an array of 15-cm rockets between its widely-spaced booms.



new tactics with their new jets. A heavy weapons load forced the A 21Rs to always remain at low level, flying below radar. The A 21Rs were armed with 15-cm and 18-cm rockets, up to 10 of which could be carried along with the standard gun/cannon armament. An external gun pod was developed for the A 21R which featured eight 8-mm machine-guns, and the simultaneous firing of all 13 guns was an extraordinary sensation for the pilot. F7 passed its A 21Rs on to F17 at Ronneby in 1954, and they were retired from service in 1956. The last piston-powered J 21s were retired in 1953, when they were replaced by J 28 Vampires and Saab J 29 Tunnans.

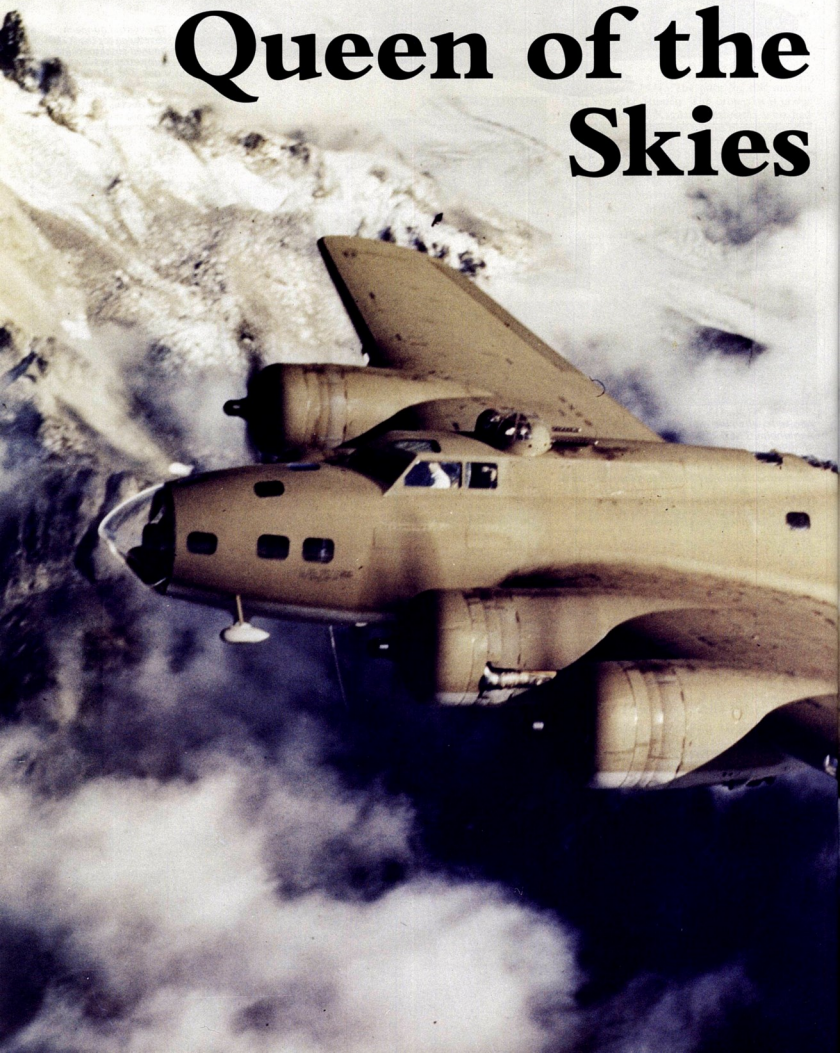
The J 21A was a remarkable achievement for a fledgling aviation industry and achieved as much as many contemporary US, British and German aircraft which were driven by a huge war effort. It will retain a place in the history books for its introduction of the ejection seat and its conversion to the J 21R. The J 21R was less remarkable, as an aircraft, but it did provide an invaluable introduction to high-speed aircraft and engine design, aerodynamics and operational procedure. Saab and Sweden put this to good use in a string of successive designs, including the Lansen, Draken and Viggen, that led to today's JAS 39 Gripen, all of which are among the best combat aircraft ever built.

Robert Hewson

The shape of things to come: a J 21R sits beside its swept-winged successor the Saab J 29. In terms of engineering alone the J 29 was at least a generation ahead, but they flew together, briefly.

Boeing B-17 Flying Fortress

Queen of the Skies



Boeing's B-17 was not the biggest of the US heavy bombers of World War II, nor the most numerous, nor even the one with the heaviest armament, yet the public's perception of the bomber campaign against Germany largely centres on the image of the Flying Fortress battling flak and fighters to lay waste to Hitler's own 'Fortress Europe'. Hardly suitable for a real war when it entered service, the B-17 benefited from the RAF's bitter experience with early models, and by the end of 1943 was sufficiently well-equipped and available in large enough numbers to live up to its early promise. Arguably more glamorous and more colourful than its contemporaries, the B-17 inspired confidence in, and affection from, those who had to entrust their lives to it day after day through years of bitter war.

A factory-fresh B-17F-80-BO is photographed on a pre-delivery flight with the customary background of Mt Rainier in Washington State. Before it ever dropped a bomb on Europe – its most likely assignment – as many as 60 modifications and refinements would have been scheduled to make the bomber combat-ready, although many would never be carried out by the hard-pressed Air Depots. If its crew had the time and the inclination, it would receive a name, and maybe a bathing beauty or cartoon character would adorn its nose. If it survived the flak, the fighters, the risk of collision and the weather, a tally of mission symbols would amass on its nose, the pristine army paint scheme would begin to vanish under division, group and squadron identification markings, and panel-by-panel it would be dented, stained, chipped and torn. The most serious wounds would be patched with sheet metal and bits of other aircraft too battered to fly again. If it escaped the fate of a 'hangar queen' itself and by some miracle saw the war out, then its fate would almost certainly not be to fly on as a civilian or to be pampered in a museum, but to sit in a corner of one of the German airfields it had helped level, or in the Arizona desert until the time came for the scrapman to return it to ingots.

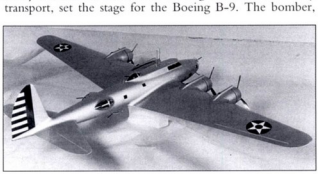
Above: A crowd gathers to watch the roll-out of Boeing's Model 299, Seattle, 17 July 1935. Nine days later, the Flying Fortress (a name coined by a local reporter the day after the unveiling) made its first flight.

Below right: This model of the B-299 appeared early in 1935, by which time the prototype was under construction. The configuration of the new bomber changed little from the initial proposals, although liquid-cooled engines and a twin-engined layout were considered at one time.

Below: Some of the B-17 design and engineering team are seen at the roll-out. Edward Wells, then assistant chief engineer, stands third from the right. Regarded as the 'Father of the B-17', Wells was only 25 at the time.

In the early 1930s, the United States was in the throes of an economic depression. Funds for the Army Air Corps – which was not a favourite of the Army General Staff – came quite frugally even though there was dire need for new equipment, namely aircraft. The bomber force was equipped with unlikely Keystone twin-engined biplanes that struggled along at 110-115 mph (177-185 km/h), were quite unmanoeuvrable and lightly armed, and could carry only a limited bomb load. The only thing in the aircraft industry that was pushing ahead was the development of commercial aircraft for the burgeoning air passenger business. This brought about some revolutionary designs in all-metal monoplanes that set the ground work for future bombardment aircraft.

Clairmont Egtvedt of Boeing Aircraft Company had long had an idea for the ultimate bomber but he had been unable to pursue it due to lack of interest from the US Army and lack of funds. The Boeing Monomail, an early transport, set the stage for the Boeing B-9. The bomber, which was given the experimental designation XB-901, was powered by two 575-hp (430-kW) Pratt & Whitney R-1860-13 Hornet engines and was of all-metal construction, with retractable landing gear. The first flight was made on 13 April 1931 by test pilot Les Tower, and the aircraft flew to Wright Field, Ohio for further testing in June of that year. The aircraft's average speed of 158 mph (255 km/h) en route was well received. The Army purchased the prototype, as well as the second uncompleted aircraft which was to be equipped with V-1570 inline liquid engines.

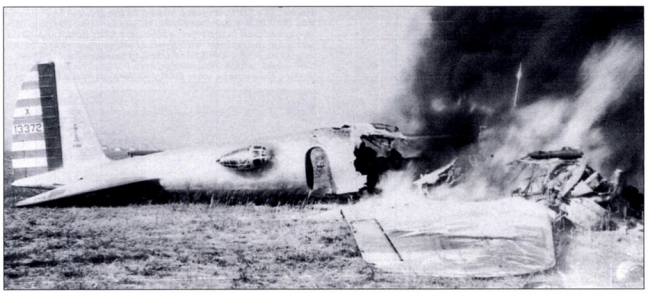


Obsolete bombers

The original prototype was re-engined with supercharged Pratt & Whitney R-1860-11 engines which boosted the top speed to 188 mph (302 km/h) at 6,000 ft (1830 m). This aircraft was redesignated YB-9. Five subsequent aircraft equipped with the same engine were designated YB-9A and were delivered to the Army Air Corps in 1932-33. The second prototype, with the Curtiss V-1570 engine, received 'inferior' performance ratings and the engines were replaced with the Pratt & Whitney model.

Although the B-9's performance was much superior to that of the obsolete Keystones, the aircraft was itself outclassed by the new Martin B-10 bomber. This featured

Below: The Model 299 epitomised the state of the aeronautical engineer's art in 1935, although it contained few features that were actually all-new. Built without a specific contract from the government, the bomber constituted a large risk to the modestly-sized Boeing company in 1934.



Left: Disaster struck Boeing's bomber dreams on 30 October 1935 when the B-299 crashed at Wright Field after the pilot attempted to take off with the elevator gust locks still engaged. Although the type was a certainty to win the fly-off, the crash precluded completion of the trials programme and the contract for a production batch was cancelled. The Douglas B-18 was selected to fill the Army's new requirement for a 'medium' bomber.

enclosed cockpits for the crew, a transparent nose gun turret and twin Wright R-1820 engines which gave the aircraft a top speed of 213 mph (342 km/h) – allowing it to outrun the fighter aircraft of the day.

In February 1934 the Army General Staff approved the Air Corp's Project A, which called for preliminary designs and engineering data for an aircraft that would be capable of carrying a 1-ton bomb load over a distance of 5,000 miles (8050 km). In view of the fact that the project was experimental, only one aircraft would be built. This became the Army's Project X. Boeing was the successful bidder and the designation XB-15 was issued, with a factory designation of Model 294.

The aircraft's configuration was like that of the B-17, only on a larger scale. (The B-17 actually flew before the XB-15, which did not take to the air until 15 October 1937.) The one-of-a-kind XB-15 was larger than the B-17, with a wing span of 149 ft (45.4 m) and a length of 87 ft 11 in (26.8 m). It had internal wing passages for inflight engine maintenance. Unfortunately, it was grossly underpowered: its four 850-hp (637-kW) Pratt & Whitney Twin Wasp engines gave it a very disappointing top speed of 195 mph (314 km/h). In 1943, the aircraft was converted to a transport with cargo doors and was redesignated XC-105; it performed cargo duties until the end of World War II.

Model 299

In accordance with War Department doctrine of the time, there was no way the Army Air Corps could request an aircraft that would be classified as an offensive weapon; it would have to be one that was essential to the defence of the United States. The powers of the Air Corps were men such a Henry H. Arnold, Carl A. Spaatz and George Kenney, all strong advocates of heavy bombardment that would not be directed against civilian targets but would be capable of destroying an enemy's capability to make war. Opportunity presented itself to Boeing on 6 August 1934, when a circular from Wright Field invited bids on a multi-engined aircraft that would be capable of carrying 1 ton of bombs at 200 mph (322 km/h) over a distance of 2,000 miles (3220 km). The prototype of the aircraft would have to delivered within one year.

Boeing's design for the project became the Model 299. The company sought to have it registered as X-299, since it was an experimental aircraft, but the Air Corps objected to the 'X' prefix and the designation was changed to B-299.

A number of Boeing employees were involved in the design of B-299, but two of the most prominent people were E. Gifford Emery – project engineer during the year between the start and the first flight – and the assistant project engineer, Edward C. Wells, a young design engineer who had been out of Stanford University for just three years.

Since the requirement stipulated a 'multi-engined' design, and Boeing wanted to develop a four-engined aircraft, President Claire Egtvedt made a trip to Wright Field to see if such a design would be acceptable; the answer was yes. The Board of Directors at Boeing met on 26 September 1934 and voted to spend $275,000 on the new aircraft. At this point in the depression in the United States that was a princely sum to allocate to an aircraft that might not be approved for production.

The design itself was state of the art, and featured a semi-monocoque all-aluminium fuselage. The pilot and co-pilot sat side-by-side in a conventional cockpit. Their station was built up slightly above the nose level, where the forward gunner was seated in a glassed-in turret. The bombardier's position was just aft of the gunner, where an optically-flat panel had been cut in the floor.

Directly aft of the pilots' compartment was the bomb bay, which was fitted with a narrow catwalk to facilitate movement between the front and the rear of the aircraft. The radioman and/or navigator had a small room just aft of the bomb bay. A gunner's turret was fitted atop this room. The aft part of the fuselage was fitted with a gun turret on each side of the fuselage and another on the floor for a ventral gunner. These positions were all forward of a fuselage door, just forward of the horizontal stabiliser.

Giant bomber

The wing span was 103 ft 9 in (31.62 m) and its construction utilised two main spars built of aluminium tubing with sheet metal skin. Metal-covered trailing-edge

Below: Despite the crash of the prototype, the government ordered 13 Wright R-1820-engined Y1B-17s for service test. There was no XB-17 designation as the prototype crashed before completion of the Army trials and before a model number could be approved.

Although it did not fly until 15 October 1937, 28 months after the B-299, construction of Boeing's huge XB-15 (this time built with Army funds) had begun well before that of the Flying Fortress. As the XB-15 had greater dimensions than the doors of the old United Airlines hangar at Boeing Field in which it was assembled, like the B-299 before it had to be manoeuvred outside on wheeled dollies.

Below: The sole Y1B-17A is seen flying over Puget Sound with one of Boeing's commercial products, the Model 314 Clipper (which incidentally used the wing design of the XB-15). Distinguishable from the Y1B-17s by the lack of supercharger intakes above the engines, the Y1B-17A (37-369) was used mainly for engine development work.

split flaps were fitted between the inboard panels and the fabric-covered ailerons. The large tail surfaces were metal-covered, whereas the ailerons and elevators were covered with fabric. These movable surfaces – as well as the ailerons on the wings – were fitted with servo trim tabs.

Four large aluminium fuel tanks with a capacity of 1,700 US gal (6435 litres) were fitted into the cavities between the wing spars. Large structural skin panels on the underside of the wings made it possible to remove and replace the tanks. There were also two oil tanks, one just forward of the front spar on each wing.

The landing gear was retractable, bringing the main wheels up and forward into the inboard engine nacelles. The lower halves of the gear remained exposed in the conventional manner of the day.

The B-299 was powered by four Pratt & Whitney R-1690 Hornets. These single-row nine-cylinder engines were each capable of developing 750 hp (560 kW) at 2,250 rpm at 7,000 ft (2135 m). The propellers were 11-ft 6-in (3.5-m) three-bladed Hamilton Standard examples.

One of the more outstanding features of the aircraft was its armament. Each of the five turrets could be fitted with either a 0.30-in or a 0.50-in machine-gun. The bomb bays could hold up to eight 600-lb bombs.

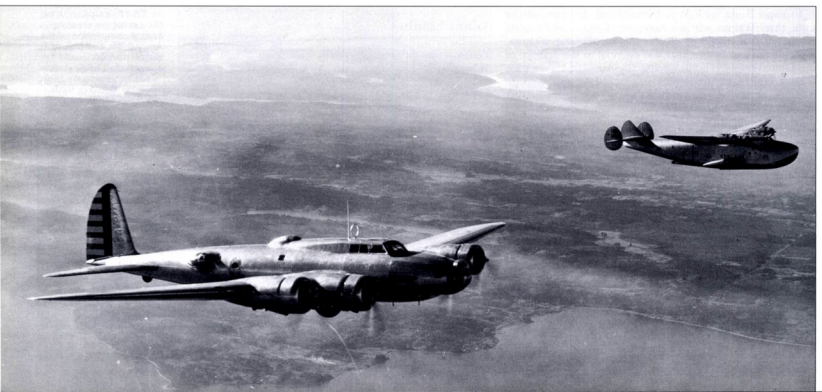
The turrets on the B-299 were instrumental in the name that the aircraft received. When the aircraft was rolled out from the factory for its initial public showing, a reporter for the Seattle Times, Dick Williams, stated that the plane was a virtual "flying fortress". Boeing quickly appreciated the publicity that the name was receiving and adopted it.

Below: The XB-15 was also known as the Model 294, Project A and the XBLR-1 (for Experimental Bomber Long Range). The largest aircraft in the world at the time of its debut, the XB-15 shared many features with the B-17 although it was far better equipped, with cooking and sleeping facilities for the crew. The wings, which incorporated crawl-spaces for engineers to service the engines, were fabric-covered aft of the mainspar.

The Fortress flies

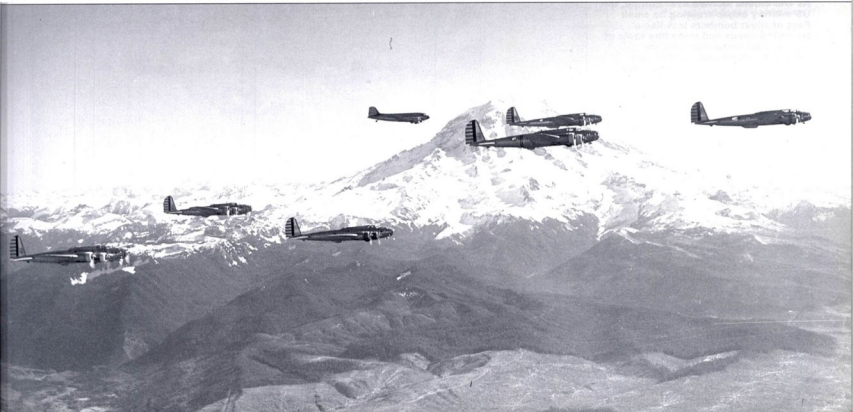
The final assembly of B-299 was completed on 17 July 1934, and it was rolled out of the hangar for ground tests. The first flight took place on 28 July with a three-man crew. Les Tower, Boeing's chief test pilot, was at the controls, Louis Wait was in the right-hand seat, and Henry Igo of Pratt & Whitney was aboard monitoring the engines. All went well, and Boeing was enthusiastic about the aircraft's success.

The aircraft made seven flights over a three-week period, for a total of just over 14 hours, before it was considered ready for its flight to Wright Field, Ohio, where it would undergo testing for Army Air Corps appraisal. B-299 took off from Boeing Field on the morning of 20 August 1935. Les Tower was again at the controls during the 2,000-mile (3220-km) flight, which was accomplished in nine hours at an altitude of 12,000 ft (3660 m). This flight broke all previous records, with an average speed of 232 mph (373 km/h).



Demonstration Flights

The Air Corps was very keen to show off its gleaming and expensive new bombers to the taxpayer, and to demonstrate their range capability. The 2nd BG at Langley, first operators of the YB-17, made a number of flights over major cities including New York (96th BS, May 1937, right; 49th BS, early 1938, above). Flights were also made to Latin America in February 1938 and to intercept the liner *Rex* 750 miles (1207 km) out to sea in May 1938, an act which greatly irritated the navy. A formation of 7th BG B-17Bs is seen below with a DC-3 near Mt Rainier, Washington in a similar, later publicity exercise.



Above: The first of the true production Flying Fortresses, the B-17B was delivered to the Air Corps on 29 July 1939. The service test period had revealed the need for a number of improvements to be made, and these included redesign of the nose to eliminate the gimballed gun socket and relocation of the bombardier from his previous prone position in the nose. An enlarged rudder and flaps were fitted, as was a revised window layout.

This flight so impressed the waiting Air Corps officials that Claire Egtvedt, who was there with the military delegation, felt sure that the B-299 would encounter little opposition from the competition. This consisted of the Martin 146 and the Douglas DB-1, the latter essentially a bomber version of the DC-2 transport.

Near-disaster

Preliminary tests were excellent and the B-299 outperformed the competition by a wide margin; it looked like the Air Corps would get the aircraft that it wanted. Then disaster struck. On 30 October 1935, Major Ployer P. Hill, chief of Wright Field's flight testing section, was in the pilot's seat, beside Lieutenant Donald Putt, the Air Corps designated project pilot, as co-pilot. Boeing's Les Tower stood behind them as an observer. The aircraft made its way down the runway and smoothly rose into the air. As it began to climb the aircraft stalled, fell off on one wing and crashed to the ground, where it burst into flames.

When the rescue team arrived at the scene, Putt, Henry Igo from Pratt & Whitney and another technician were out of the aircraft, but Hill and Tower were trapped inside. Lieutenant Robert Giovannoli leaped into the aircraft and managed to free the two men, who were rushed to the hospital. Major Hill died that afternoon without regaining consciousness, and Tower succumbed to his injuries a few days later.

It did not take long for the investigation to find the cause of the crash. B-299 incorporated a new system of mechanical control locks for the movable surfaces, which had to be released in the cockpit rather than via the old external slip-on locks. Tower failed to noticed that Major Hill had not released the locks; without control of the movable surfaces, the aircraft nosed down and plunged to the ground.

Instead of an order for 60 or so aircraft, as had been contemplated, Boeing received an order for 13 test models. Douglas received an order for 133 B-18s, as their converted DC-2 transport was designated.

Y1B-17

The contract awarded to Boeing on 17 January 1936 called for 13 YB-17s, the 'Y' indicating that the aircraft were service test rather than experimental. The assigned Air Corps serial numbers were 36-149 through 36-161. Dimensions and armament were the same as those of the B-299. The cruising speed of the aircraft was 175 mph (280 km/h) with a top speed of 239 mph (385 km/h). Service ceiling was 27,000 ft (8230 m) and range was 2,430 miles (3910 km) at 14,000 ft (4270 m).

The first model of the YB-17 rolled out of the factory on 30 September 1936, and was trucked to the Boeing Field hangar for ground tests. The new aircraft was fitted with new Wright R-1820-39 engines in place of the Pratt & Whitneys on the B-299. These Cyclones delivered 850 hp (640 kW) at 2,100 rpm at 5,000 ft (1525 m).

Other differences from the B-299 were the adoption of an individual oxygen bottle system and the change to the landing gear from dual oleo legs to single. Additional changes were made when two more fuel tanks and another oil tank were added. As the changes progressed the designation of those models was changed to Y1B-17.

More trouble developed when Y1B-17 36-149 was taken on a test flight on 7 December 1936 by Captain Stanley Umstead, chief of Wright Field's flight test section. The aircraft was equipped with bi-metal disc brakes and, although he had been warned by a Boeing flight engineer who was aboard, Umstead overheated the brakes during taxiing. Once in the air an engine overheated and Umstead

Wargames

As war clouds loomed over Europe, the US military began treating its small fleet of silver bombers less like a travelling circus and more like tools of war. Annual wargames saw the normally natural metal Fortresses adopt a variety of exotic temporary colour schemes. Y1B-17 36-152 of the 20th BS was participating in GHQ Air Force anti-aircraft manoeuvres in May 1938 when photographed (right). The B-17B (below) is seen on the ramp with its near relative, the XB-15, in similar 'enemy' camouflage. The XB-15 was accepted by the army as the XC-105 and soldiered on as a transport until 1945, when it was scrapped in Paraguay.

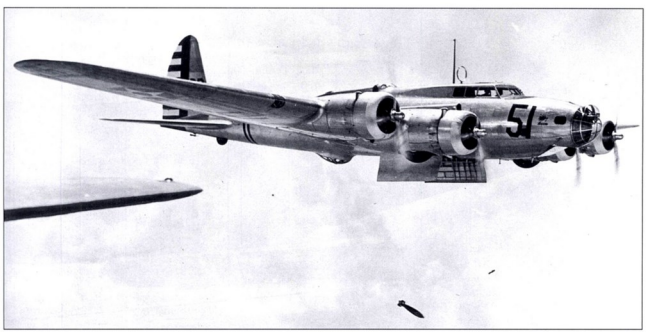
decided to bring the aircraft in for a landing. However, he did not realise that he had so excessively overheated the brakes that the brake plates had welded. Upon landing, the wheels would not roll and the aircraft wound up on its nose in the middle of the runway.

Repairs were swiftly made and the aircraft was flying again by 2 January 1937, undertaking more testing. However, the accident had further injured Boeing's chances for a new order for the aircraft. The argument was made that "the aircraft was too big for the pilots" and some factions called for more smaller aircraft rather a costly four-engined behemoth.

Y1B-17A

The next B-17 to be built was a one-of-a-kind static test article that was primarily built to develop the new turbo-supercharger system for the aircraft. It was designated Y1B-17A and assigned Air Corps serial number 37-369. Although patterned on the Y1B-17, the original construction of the Y1B-17A incorporated large intakes mounted

Above: This B-17B (38-211) was assigned to the Air Corps' Material Division at Wright Field (hence the 'MD' unit designator). One distinctive feature of the B-17B and C was the offset aircraft commander's blister behind the cockpit. On the B-17D this was moved to the centreline.



Left: Y1B-17 36-156 lets loose "a 100-pound message of death" during a bombing exhibition at Langley. Aircraft '51' belonged to the commander of the 20th Bomb Squadron of the 2nd BG. As there were only 13 Y1B-17s, each squadron had but four aircraft, with one for the HQ flight. The Y1B-17s could carry up to 20 100-lb (45-kg) bombs or two of 1,100 lb (499 kg) among a variety of optional loads, but lacked armour and defensive armament which would prove essential in a real combat environment.

Above: A B-17D takes off against the familiar backdrop of Boeing Field. Following experience in actual combat with the RAF, production switched from the B-17C to the D with a number of improvements. Many Cs were returned to the factory for modification to D standard.

Above: Only 39 B-17Bs were built, and their delivery to the army commenced in October 1939. These B-17Bs were still in front-line service at Langley in the summer of 1941, by which time the improved C and D models were in service and the first E was due for delivery. The last B was retired in 1946.

on the top of the engine nacelles for the superchargers. Test flights immediately showed that this was not going to be successful, for large-scale vibration was experienced. In due time, Boeing engineers solved the problem by moving the superchargers to the bottom of the nacelles. Once the bugs were worked out, use of the superchargers, in conjunction with the Wright R-1820-51 engines, improved the performance drastically. The service ceiling went up to 38,000 ft (11580 m) and speed at 25,000 ft (7620 m) increased to 271 mph (436 km/h), compared with the former top speed of 239 mph (385 km/h) at 5,000 ft (1525 m).

Into service

The last of the Y1B-17s was delivered to the 2nd Bombardment Group at Langley Field, Virginia on 2 August 1937. The dozen Flying Fortresses assigned to this unit were used extensively to publicise the aircraft and the Army Air Corps. Although the primary mission of the aircraft was to defend the United States, Colonel Robert C. Olds, Commander of the 2nd Bombardment Group, set out to break records and demonstrate the aircraft's intercontinental capabilities.

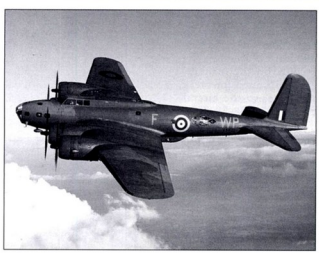
One of the first newsworthy accomplishments of a Y1B-17 was a record-breaking east-to-west transcontinental flight by Colonel Olds early in 1938, which he completed in 12 hours and 50 minutes while fighting a head wind. He then turned around and completed the flight in the opposite direction in 10 hours and 46 minutes.

Much more spectacular was the Good Will Mission flight to Buenos Aires, Argentina, to attend the inauguration of President Dr Roberto M. Ortiz. Six Y1B-17s under the leadership of Colonel Olds took off from Langley Field, Virginia, on 15 February 1938, for Miami, Florida. After a short layover they were airborne once more en route to Lima, Peru. Despite having to fly over a storm, the 2,695-mile (4320-km) trip was completed in 15 hours and 32 minutes. Due to the need for propeller adjustments, one bomber was left in Lima. The remaining five took off after a seven-hour layover and flew across the rugged peaks of the Andes to land in Buenos Aires more than 12 hours later.

There was a slight delay as the Flying Fortresses prepared to leave Buenos Aires, when one of the aircraft broke through the concrete cover of a gas pit. It was finally towed out and joined the rest of the formation in Lima. The

Douglas engineers examine a B-17C or D at their Long Beach plant. The B-17F was the first version to be contracted out to other manufacturers in addition to Boeing, but other planemakers in the US and abroad took a keen interest in the design features of the early Fortresses.

Seen here on a pre-delivery test flight, AN528 became 'B-Baker' (the first of two) with No. 90 Squadron. It was lost on 4 June 1941 when it caught fire at Polebrook while running up on the ground, and was burnt out.



'F-Freddie' (AN530) had a longer and more varied career than most of the Fortress Mk Is, serving with four units. On 2 August 1941 its crew fought the first air battle between a B-17 and enemy aircraft, bringing down two Bf 109s.

Above: The 20 B-17Cs destined for the RAF as Fortress Mk Is are seen lined up at McChord Field, Washington in February 1941. Due to a mishearing, the RAF serials were painted with 'AM' serials instead of the correct 'AN'. Of the aircraft with visible serials in this picture, AN518 was handed over to the USAAF in India in 1942; AN522 broke up in the air over Catterick in 1941; AN527 and AN530 went on to serve with Coastal Command and were struck off in 1943; AN529 force-landed in Libya in November 1941.

Y1B-17s returned to Langley Field via the Panama Canal with no further trouble. Upon their arrival at Langley they were greeted by 5,000 people, including Major General Frank Andrews, head of the GHQ Air Force.

Flying the flag

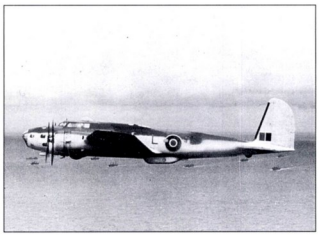
Three days later seven Flying Fortresses from the 2nd BG formed up under the leadership of Major General Delos C. Emmons and departed on a 12,000-mile (19300-km) trip to Rio de Janeiro, Brazil. The journey was trouble free and helped to prove that the new four-engined bomber was certainly not too much for the pilots. Regardless of the success of these flights, there was a concerted movement in the War Department not to build any more multi-engined bombers and to concentrate on lighter types that could provide close support for ground forces.

One more significant mission by the 2nd Bombardment Group garnered headlines that should have strengthened the cause of the bomber advocates but instead brought about a sharp rebuff. In May 1938 three Fortresses set out to prove the type's navigational skills and ability to defend the coasts of the United States by intercepting the Italian ocean liner *Rex*. Colonel Olds was leading and the navigation was in the hands of an officer who later gathered extraordinary fame in World War II, Lieutenant Curtis LeMay. The Y1B-17s successfully found the ship, still over 700 miles (1125 km) from American shores, and swooped down to drop a message on the deck.

The pilots returned to Langley Field exuberant at their success not only in navigation but in proving their ability to intercept any invasion force approaching American shores. No sooner had the news been made public than the US Navy protested the action to the General Staff. A verbal order was swiftly issued by General Malin Craig, US Army Chief of Staff, restricting actions of the US Army Air Corps

In 1941 the B-17 offered the RAF true high-altitude bombing performance compared to the Stirling and Halifax then entering service. Sadly, the promise of daylight strategic bombing in Europe was unfulfilled by the RAF's Fortress Mk Is. Before this became evident through bitter experience, one of the new aircraft was among a number of then-current types demonstrated before the Prime Minister on 6 June 1941 at West Raynham, No. 90 Sqn's base.

Right: One of No. 90 Squadron's Fortresses runs up its engines on a brilliantly clear day. The concept of unescorted loose formations bombing Germany, even at the B-17's high altitudes, was a flawed one. The most combat missions any Bomber Command Fortress Mk I flew was nine, and several flew only one before being withdrawn due to unforeseen technical problems associated with high-altitude flight in the European climate.



Far right: Four of the surviving Fortress Mk Is were sent to the Middle East, two of those going on to India. The remainder were handed over to Coastal Command, serving primarily as trainers for Nos 206 and 220 Squadrons, who were awaiting delivery of Fortress Mk IIs (B-17Es). This is AN537 of No. 220 Sqn. The last operational Fortress Mk I sortie was in July 1942.

to a 100-mile (160-km) limit from the shores of the United States. Beyond that was strictly US Navy jurisdiction.

B-17B: the first production model

The Air Corps called for new bids on multi-engined bombers in March 1936 before the opposition to such aircraft became an issue. After much dispute over price and alterations, a contract was signed on 3 August 1937. It resulted in the manufacture of 39 B-17Bs. Contractual changes caused for breaks in the assigned Air Corps serial numbers, so the aircraft were designated 38-211/223, 38-258/270, 38-583/584, 38-610 and 39-110.

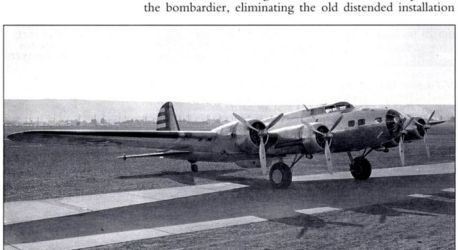
The B-17B was little changed from the Y1B-17 except for the installation of turbo-superchargers, which had been proved on the Y1B-17A. The new fuel system changes were made and the rotating nosecone gun turret had been eliminated. The redesigned nose featured a view plate for the bombardier, eliminating the old distended installation behind the nose turret which had housed the bombardier's view plate. Also changed in the nose was the installation of a station for the navigator on the left-hand side of the fuselage behind the bombardier.

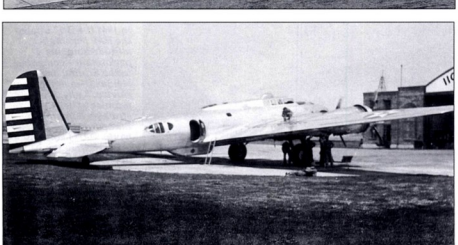
The B-17B returned to all-metal flaps, which were also enlarged in width between the inboard panels and the ailerons. A Plexiglass bubble was installed behind the flight deck for an aircraft commander's station.

The first B-17B was delivered on 20 October 1939, and the last on 30 March 1940. None of the B-17Bs served outside the United States.

B-17C

The Army Air Corps again requested bids for more bombers on 11 March 1939. On 30 September Boeing received a contract that put the first of 38 B-17Cs under construction. These aircraft were serialled 40-2042 through



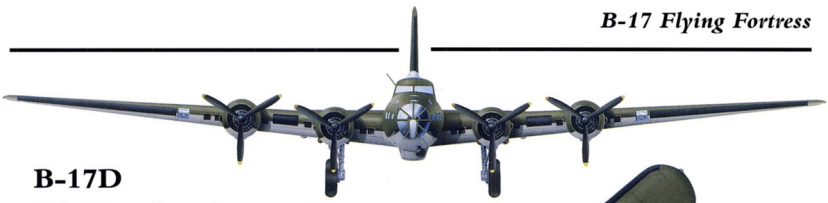


B-17D

The Royal Air Force's experiences with the B-17C, which was simultaneously entering service with the USAAC, highlighted a number of deficiencies of the type as a combat aircraft. Some of the concerns raised by the RAF, such as the formation of giveaway condensation trails at altitude, inaccurate bombing due to the difficulty of using the Sperry bombsight, and inadequate bomb load could not easily be addressed. Boeing and the Air Corps, however, did introduce changes to the 'shark tail' Forts still in production, although solutions to problems such as lateral instability and rearward defence were in hand with the impending arrival of the 'big ass' B-17E.

Thirty-two changes were specified by the Army for the second batch of B-17Cs, and these proved so extensive that the new aircraft were redesignated as B-17Ds. The only obvious external difference between the two models was the addition of cowling flaps to better regulate engine cooling, but internally there were many changes, including the addition of bladder-type fuel tanks, armour plate, a 24-Volt electrical system, modifications to bomb racks to prevent freezing at altitude and deletion of lower windows for oblique photography. Most significantly, armament was doubled in the ventral and dorsal positions and additional socket positions were added for the nose gun. New B-17Ds were delivered in natural metal finish, but B-17Cs returned by the Air Corps for modification were painted in the new olive drab over neutral grey scheme then appearing on Army aircraft. These modified Cs had all the internal changes specified for the D, but not the cowl flaps, making identification of the two versions extremely difficult.

Left and above left: Early B-17s did not carry visible serial numbers and the group designator system was not universally used (and was abandoned completely after Pearl Harbor), making many early series Flying Fortresses completely anonymous. The B-17D at left is from the 7th BG and is seen at St Louis during a cross-country flight from Hamilton Field, California, in early 1941, before fuselage national insignia was introduced.



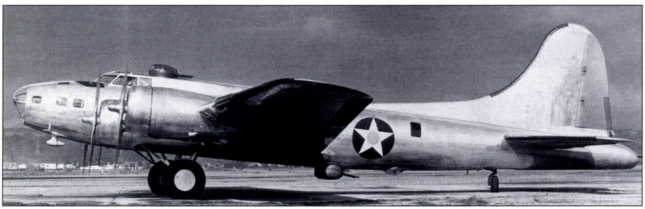
B-17D
7th Bombardment Group
Pacific Theatre of Operations, 1941/42

B-17D
Partly due to feedback from early RAF operations with the B-17C, many improvements were suggested during the course of production of the 80 aircraft ordered for the USAAC and RAF. A large number of these were adopted for the second batch built so that only the first 38 aircraft were completed as B-17Cs, the remainder being regarded as a completely new model and designated B-17Ds. Externally, the B-17D incorporated only relatively minor changes from the B-17C. Most noticeable of these was the addition of cowl flaps for the engines which allowed better regulation of the cylinder head temperature, and the relocation of the aircraft commander's astrodome from the starboard side of the fuselage behind the cockpit to the centreline. Other, less visible changes included increased armour protection, self-sealing fuel tanks, redesigned bomb racks and a low-pressure oxygen system.

Armament
The B-17D model carried seven machine-guns, six of 0.50-in calibre and one of 0.30-in. The latter weapon, for which 500 rounds of ammunition was carried, was intended for mounting in one of three sockets in the nose Plexiglass. The 0.50-in guns were installed in the waist positions, top hatch (two) and ventral 'bathtub' (two). The top hatch and ventral guns were twin installations, unlike those in the B-17C. The Y1B-17 through B-17B had tear drop waist windows with the guns mounted on an ingenious but complicated gimbal which incorporated part of the external window. On the B-17C, the gimbal was replaced by a simple swivel post and the teardrop windows with flat panes. The ventral gun position and the radio room gun on B-17 models prior to the B-17C had been mounted in similar gimballed blisters, but these were replaced on the B-17C with a sliding hatch, similar to that used on subsequent models, and an underslung bathtub, respectively. The bathtub was similar to that fitted to the He 111 and other contemporary bombers and was fired by the gunner in a kneeling position on the padded floor. Unfortunately, the firing arc was, if anything, even more limited than with the earlier position and the gunner's position more uncomfortable. On the B-17E, a more conventional turret was added, but the problems of defence of the bomber's underside were not solved until the development of the manned ball turret as introduced later in B-17E production.

Camouflage and insignia
In October 1941, the first camouflaged B-17s started to be delivered from the factory following the adoption of camouflage for all Air Corps combat aircraft in the previous month. The red spot in the centre of the national insignia was ordered to be removed on 15 May 1942. The red and white (with blue vertical) tail stripe marking also disappeared from most Army aircraft at this time, although Navy aircraft retained them a little longer and some B-17s serving on coastal patrol from Hawaii wore them until the Navy stopped doing so.

Identification markings
Until September 1942, B-17s carried no visible serial numbers other than that on the aircraft's data block near the cockpit, but were identified by a code system on the vertical tail fin. This consisted of an aircraft-in-group number (in this case 10) and a unit designator (7B for 7th Bombardment Group). This system replaced the outwardly similar pre-war one in which the aircraft number was below the unit designator, which consisted of B for bomber and a letter representing the group's number's position in the alphabet. Under this system, 7 was G and this aircraft would have worn BG over 12. This system was phased out in early 1940.



B-17E

The B-17E introduced the most radical changes from the previous model of any B-17 variant. The contract for 150 aircraft was signed in June 1940 and the B-17Es were intended to follow on directly from the B-17Ds. Delays (mostly political) caused a break in production before the first B-17E rolled out in September 1941. The new aircraft was unlike the previous Flying Fortresses in that it had a completely new rear fuselage and tail. The enlarged tail surfaces countered the high-altitude instability of earlier B-17s and the bigger rear fuselage allowed for increased defensive weaponry, including adequate tail protection in the form of a manned tail 'stinger' position with two guns. Engines remained unchanged, but gross weight increased by 2,000 lb (907 kg).

Above and top: Two views of early B-17Es at the Boeing factory, both showing the new Bendix ventral turret and its remote-sighting dome. The top aircraft is the prototype and wears unusual markings for a natural metal-finished aircraft of the period, but they are correct for the camouflage scheme to be applied before delivery.

On a test flight, the first B-17E (41-2393) shows off its enlarged tail feathers and Sperry top turret. The rudder is painted olive drab for balance reasons.

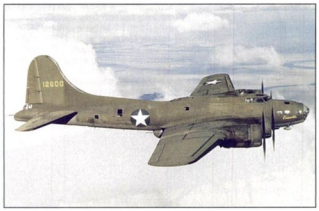
40-2079. The major visible changes on the aircraft were in armament. The redesigned B-17B nose remained, but all the streamlined blisters on the fuselage were eliminated. The waist guns were mounted inside the fuselage in flush-fitting installations. The transparent blister over the radio room was gone and the gun was placed in a transparent hatch faired into the fuselage contour. A new 'bathtub'-type installation was fitted in the belly of the aircraft which permitted the gunner to kneel while facing downward and to the rear. Boost pumps and transfer pumps were installed to make fuel available to any engine. The oxygen system was changed to a manifold system shared by a number of the crew.

The first B-17C flew on 21 July 1940, and was accepted by the Air Corps on 5 August. The remaining B-17Cs were delivered by 29 November 1940.

During 1939-1940 the Boeing B-17 programme was almost dropped. In 1939 Boeing found itself losing money on the aircraft. It proposed a new figure of $205,000 per aircraft, but the Air Corps refused to accept it. Boeing was told that the Army would pay $198,000 and 'not a dime more'. Even with World War II under way in Europe, there was no compromise between Boeing and the Army Air Corps. General H. H. 'Hap' Arnold had just been appointed Chief of the Air Corps and did his best to negotiate a price settlement, but to no avail. Even though Boeing had the B-17C under construction at the time, it seemed that there would be no financial solution and that production of the aircraft would be dropped.

A final meeting for negotiations was called, for what Boeing was already referring to as a dead issue. Arnold sent General Carl Spaatz to the meeting as his representative, and Spaatz knew he had to do something or the heavy bomber programme would come to an end. It was he who suggested that they should see what could come off the aircraft to reduce the price. This tactic was successful and a rock bottom price of $202,500 was agreed; the Flying Fortress was still a viable product and the B-17Ds would be

Below: B-17E deliveries began as soon as the first aircraft had completed a limited test programme. Most aircraft went to the Pacific theatre and only a few arrived in Europe.* Esmerelda, *seen here, sports the Sperry manned ball turret introduced from the 113rd aircraft on.



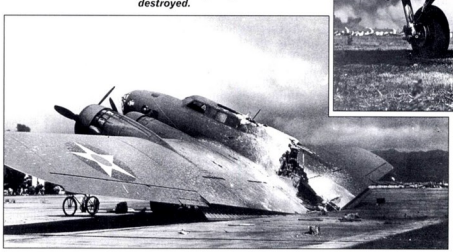
Pearl Harbor

When forces of the Imperial Japanese Navy attacked American bases in the Hawaiian Islands on 7 December 1941, the Flying Fortress was in the thick of the action. Unfortunately, due to the lack of preparedness of US forces at the time, the pride of the Army Air Forces (renamed from Air Corps on 20 June 1941) mostly became targets for Japanese fighters and bombers which roamed the Hawaiian skies virtually at will. It was the misidentification of the Japanese attack force as a flight of B-17s expected from the mainland that prevented an alert being given in time to organise the defences. As it happened, the six B-17Cs and eight B-17Es of the 7th and 19th BGs that arrived over the islands as the raid was in progress came under attack from Japanese 'Zeros' and even 'Val' dive-bombers. Most were damaged by them or in attempting to land away from the main airfields. The aircraft, which were on the way to reinforce the Philippines, were carrying no ammunition for their guns as a weight-saving measure. Twelve B-17C/Ds assigned to the defence of the islands were on the ground at Hickam when the attack came and five of these were destroyed on the ground, with many others damaged. Over the next few days, those aircraft that could be repaired or flown back to Hickam were put on shipping patrol and anti-submarine duties. Shortly afterwards, the US bases in the Philippines came under attack and a further 17 B-17s were destroyed or damaged.

Above: B-17C '49' of the 38th Reconnaissance Squadron, 19th BG was forced to land at Bellows Field 40 miles (64 km) from Hickam. Pilot Robert Richards made a downwind landing and the bomber wrecked a P-40 before coming to rest. Subsequently, the B-17 was strafed by 'Zeros' and destroyed.

Far right: One of the aircraft that did make it to Hickam, a B-17E of the 38th RS, frames a B-17D of the 18th Bomb Wing, Hawaiian Air Force. Most of the locally-based bombers were lost in the attack, although one or two were able to make patrols in the following days.

Right: The only other B-17 airborne at the time of the attack – which was completely destroyed – was that of Captain Raymond Swenson. Also from the 38th RS, Swenson's B-17C was struck by cannon fire from 'Zeros' as it landed at Hickam. A flare storage box ignited and the aircraft caught fire in the air, with the tail breaking off on the runway. Eventually the bomber came to rest just short of the Hale Makai barracks. One passenger was killed.



contracted at that price.

Forty-two B-17Ds were built, with serial numbers 40-3059 through 40-3100. There were very few significant changes between this aircraft and the B-17C. The one distinctive feature on the B-17D was its cowl flaps on the engine nacelles. Due to the war, bladder-type self-sealing fuel tanks were installed and a low-pressure oxygen system was utilised.

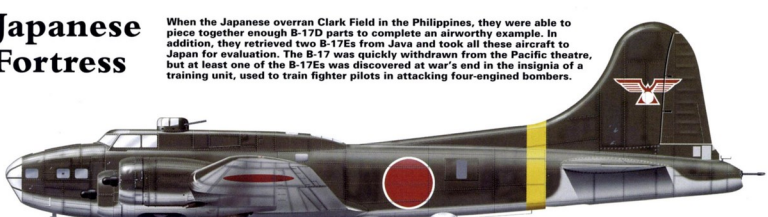
The B-17Ds were delivered between 3 February 1941 and 29 April 1941. Some were delivered in natural metal and others were painted in olive drab and grey at various Army depots. At the same time, B-17Cs were modified to B-17D standard. These two types of Flying Fortresses were the initial participants in World War II by what would become the Army Air Forces.

With the Royal Air Force

Following the fall of France in 1940, the British were desperate for aircraft of any type. Through a lend-lease agreement the first 20 B-17Cs off the line were turned over

Japanese Fortress

When the Japanese overran Clark Field in the Philippines, they were able to piece together enough B-17D parts to complete an airworthy example. In addition, they retrieved two B-17Es from Java and took all these aircraft to Japan for evaluation. The B-17 was quickly withdrawn from the Pacific theatre, but at least one of the B-17Es was discovered at war's end in the insignia of a training unit, used to train fighter pilots in attacking four-engined bombers.



A pair of B-17Es from the second production batch is seen flying in the US. With America's entry into the war, aircraft originally destined for export were re-acquired by the USAAF, hence the RAF-style camouflage and fin flash on the foreground aircraft. This aircraft wears the azure blue undersides and fin adopted during the Fortress operations of No. 90 Sqn. None of the B-17Es that served with the RAF wore this finish.

Below: In the desperate days after Pearl Harbor, aircraft, ammunition, bombs and ground equipment were in short supply in Hawaii, much of this materiel having been lost in bombed storehouses. Here a B-17E is hand-loaded with a mix of bombs from 100 lb (45 kg) to 600 lb (227 kg). Ropes sometimes had to be used to haul the bombs into the bay.

to the Royal Air Force. These aircraft received RAF serial numbers AN518 through AN537. Even though the aircraft were turned over to the British by late 1940, it was May of 1941 before the first of the Fortress Mk Is arrived at Wright Field to be fitted with self-sealing fuel tanks and further modified to Royal Air Force requirements.

Upon arrival in the UK the aircraft were assigned to No. 90 Squadron with the instruction that they should only be used as training aircraft. Combat duty should not begin until the crews had been thoroughly trained. Nonetheless, the Fortress Mk Is were soon in action. Equipped with a Sperry bombsight rather than the top secret Norden, three of the bombers set out on 3 July 1941 to bomb the naval barracks at Wilhelmshaven, Germany. Two of the Fortresses made the bomb run at the extreme altitude of 30,000 ft (9145 m), but scored no hits on the target. Enemy fighters rose to challenge, and the gunners found themselves defenceless as their guns were frozen. The Fortresses managed to make it back to base unharmed.

Fortress Is joined up with other members of the RAF's Bomber Command to attack the German battle cruiser *Gneisenau* on 24 July 1941. The three Fortresses attacked from 30,000 ft in the hope that the Luftwaffe would come after them and not the Hampdens and Wellingtons at lower altitudes. The raid went according to plan but the high-flying Boeings scored no hits; they were able to attract some of the German fighters, which severely damaged one of their number.

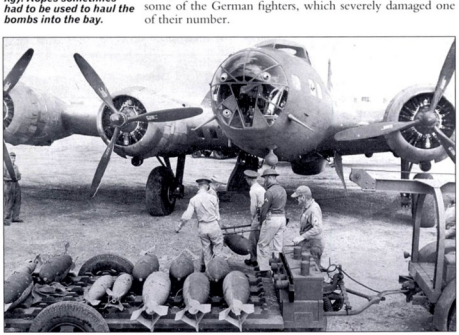
The view from behind the bombardier on a B-17E. The distinctive nose framing of this model is shown well as is one of the three optional sockets for an 0.30-in calibre gun.

First Fortress losses

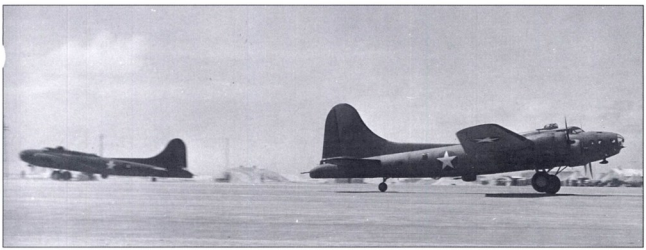
Additional missions by the Fortresses were few and far between. Two of them set off on a mission to Hamburg on 26 July but one turned back when thunderstorms were encountered. The other aircraft dropped its bombs on Emden. Both returned safely. On 16 August four Fortresses set out to bomb Brest and Dusseldorf. One of the aircraft was set upon by five German fighters over Brest and had to fight its way back to England, where it crash-landed.

The last ambitious operation by the Fortress Mk Is was carried out on 8 September when four set out to attack the German battleship *Admiral Scheer* at Oslo, Norway. They encountered heavy fighter opposition from the Luftwaffe and two of the bombers were shot down; a third managed to make it back to England, where it crash-landed.

The last attempt at combat operations by No. 90 Squadron in the Fortresses was on 25 September 1941, when one bomber took off for Emden but was forced to



In the farther reaches of the Pacific, proper maintenance facilities were scarce. The national insignia without central red spot dates this scene of a B-17E crew cleaning their guns (and, less plausibly, their bomber) to early 1942.



A B-17E takes off from Midway Island to attack the Japanese fleet on 4 June 1942. The land-based bombers in the Battle of Midway were generally ineffective, although they divided the enemy's attention and tested their defences. The B-17s, consisting of detachments from the 5th and 11th Bomb Groups, flew 62 sorties and claimed many hits on warships, although never actually got a bomb closer than 50 yd (45 m).

turn back due to bad weather. This concluded the highly unsuccessful period in which the Royal Air Force initiated the Boeing bomber into combat.

Inauspicious debut

Although the operations of the Fortress Mk I had not gone well, a number of the crew members of No. 90 Squadron liked the aircraft. It had excellent flying characteristics and operated well at very high altitude. Had the crews been given sufficient time to become proficient in the aircraft, and had the missions not been flown at such high altitudes, it is possible that they might have been quite successful.

The operations by the Royal Air Force did not discourage the bomber advocates of the US Army Air Force (the Army Air Corps had become the USAAF effective 20 June 1941) and General H. H. Arnold commented that, "the British never gave the Fortress a chance."

War comes to the USAAF

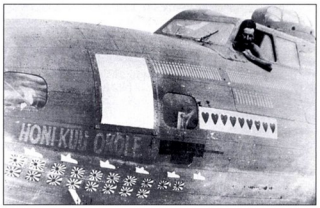
Of the 42 B-17Ds delivered, 35 were sent to Hawaii and the Philippine Islands. Twenty-one were involved in a mass flight from Hamilton Field, California to Hickam Field, Hawaii on 21 May 1941. The 2,400-mile (3860-km) trip was accomplished in the excellent time of 13 hours and 10 minutes. Nine of these Fortresses were sent on to Manila in the Philippines on 5-12 September 1941, via Midway and Wake Islands, Port Moresby, New Guinea and Darwin, Australia. By the end of November 1941, 26 revamped B-17Cs and Ds were in the Philippines. Another dozen Fortresses were on the ramps in Hawaii on the morning of 7 December 1941.

The B-17 Flying Fortress flew directly into the war with the Japanese when 12 en route from California to the Philippines arrived over Hawaii during the attack on Pearl Harbor. Six B-17s under the command of Major Richard H. Carmichael of the 19th Bombardment Group arrived during the first wave of the attack. Unable to get into Hickam Field, Carmichael and one of his flight managed to land at a short fighter strip to the north. Another put down on a golf course and the other three were able to land at Hickam Field following the attacks by the first wave.

Pacific disasters

A second flight of six B-17s, commanded by Major Truman Landon, managed to get four of their number on the ground just as the second wave of the Japanese attack

Pacific nose art



The Pacific theatre saw the first real stirrings of one of the enduring art forms to be brought out by war: the naming and personalising of combat aircraft, particularly bombers. US Army aircraft had been decorated before by their crews, but usually with a simple name. In the combat zone, however, it seemed that every B-17 wore a name, a girl and a tally of bombs and flags denoting battles fought. In truth, perhaps less than half of them did, but this is how they have become remembered, not least due to the requirements of propaganda. Three notable early Fortresses in the Pacific are shown here. The unnamed 43rd BG B-17F at left, seen at Dobodura in 1943, sports 109 mission symbols, 17 aircraft and nine vessels destroyed and at least seven purple hearts denoting wounds to crew members. *Honi Kuu Okole*, (centre), with its side-window gun mount obscured by the censor, has nearly as impressive a scoreboard, including 63 missions. *Typhoon McGoon II* of the 98th BS, 11th BG has only eight missions to its credit, but the largest of its rising sun flags denotes a 'Mavis' flying-boat. Unusually, the ASV radar aerial has escaped the censor.

Above: Captain Colin Kelly of the 19th BG was America's first air hero of the war, although the results of his final mission were exaggerated for propaganda purposes. On 10 December 1941 he piloted a B-17C to a damaging attack on a Japanese cruiser and stayed with his burning bomber until his crew could escape. He was posthumously awarded the DSC.

***Suzy Q** was one of the few B-17s to survive a tour in the Pacific and return to the US, where it is seen on a war bond drive. The aircraft, from the 93rd BS, 19th BG, flew missions from the Philippines, Darwin, Java and Borneo during the long period of Allied setbacks in the early months of the war.*

arrived. The aircraft flown by Captain Raymond Swenson came under fighter attack and was destroyed on the runway as the crew fled the aircraft. The last Fortress in the flight also was pounced upon by fighters. All of the Fortresses were defenceless, for they carried unloaded machine-guns. Two crew members were wounded before Lieutenant Robert Richards managed to land his B-17 at Bellows Field.

Boeing B-17Cs and Ds belonging to the 19th Bombardment Group in the Philippines were somewhat dispersed when war came, but 19 were present at Clark Field. When news came of the attack on Pearl Harbor, one of the Fortresses was immediately dispatched on a reconnaissance mission to Formosa. Colonel Eugene Eubank, group commander, immediately went to General Douglas MacArthur's headquarters for a conference and 14 of the B-17s were put into the air for their protection against an enemy attack. When no attack was forthcoming, the Fortresses landed.

No orders came from MacArthur's headquarters for the bombers to attack Formosa, nor were there any orders from the headquarters of Major General Lewis Brereton, Commander of the Army Air Forces in the Philippines. While the commanders hesitated, the Japanese came. Three B-17s were taxiing out for a photo mission when the bombs began to fall; all were destroyed. When the Japanese bombers were through, the 'Zero' fighters came down to strafe. After they had completed their work, 12 of the Fortresses had been completely destroyed, including two that had been taxied out of a hanger in an attempt to save them. All the rest of the B-17s had been badly damaged. Only two of the 18 B-17s at Clark Field remained serviceable at the end of that day.

In the classic picture of Pacific war Flying Fortress operations, B-17E Aztec's Curse of the 11th Bomb Group pulls off the target on Guadalcanal.

First USAAF B-17 mission and first hero

By 10 December a number of the B-17s of the 19th Bombardment Group had moved up from the south, and the unit's first bombing mission was planned. The initial flight was composed of five B-17s from Del Monte led by

Above: As the war in the Pacific progressed, permanent maintenance facilities became established away from the front line. Here receiving attention along with B-26s, a P-38 and a P-39 at the 13th Air Depot, Tontouta Air Base, New Guinea, is an unusually camouflaged B-17E.

Left: Freezing air at high altitude was not the problem for gunners that it was in Europe, but, on the other hand, formations were rarely large enough to provide mutual defence.

Captain Cecil Combs. They made individual attacks on Japanese transports in the Lungayen Gulf where the enemy was unloading its invasion forces. Using only 100-lb bombs, the few hits that were made on the ships caused little damage.

Four B-17s from San Marcelino landed at Clark Field that morning and were bombing up when an air raid alert forced them to become airborne before all had been fully loaded. One of these was the B-17C Fortress flown by Captain Colin Kelly, the bomb bay of which contained only three 600-lb bombs.

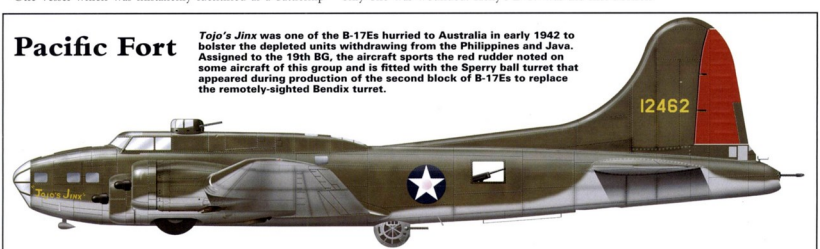
Kelly headed for invasion shipping at Aparri. Upon arrival, he observed several ships unloading troops but further out to sea warships were shelling the coastal area. One vessel which was mistakenly identified as a battleship was attacked by Kelly's aircraft: the first bomb fell short, the second just missed the bow and the third struck the aft gun turret. The crew reported a battleship sunk, but later information confirmed only a damaged cruiser.

As Kelly turned back for Clark Field his aircraft came under attack by Japanese 'Zero' fighters. The attack started a fire in the bomb bay and killed Sergeant J. W. Delehanty, the engineer gunner. Kelly had gone down to 12,000 ft (3660 m) when the Fortress was hit again and developed another fire in a wing tank. The B-17C had not been modified and did not have self-sealing tanks. Kelly held the aircraft level, allowing his crew to bail out, until he was too low to exit himself. His body was found at the crash site. The crew was gunned in their parachutes but only one was wounded. Kelly's B-17 was the first Fortress

By the time camouflage was giving way to natural metal on the production lines, the B-17 had been withdrawn from the Pacific. In March 1943 there was one 'silver' B-17 in the theatre – Gen. George Kenney's personal B-17E Sally. Unlike the later C-108s converted for VIPs, this aircraft retained the top turret.

Pacific Fort

***Tojo's Jinx* was one of the B-17Es hurried to Australia in early 1942 to bolster the depleted units withdrawing from the Philippines and Java. Assigned to the 19th BG, the aircraft sports the red rudder noted on some aircraft of this group and is fitted with the Sperry ball turret that appeared during production of the second block of B-17Es to replace the remotely-sighted Bendix turret.**



With America suddenly fighting a war on two fronts, the aircrew training effort and the formation of new groups went into overdrive. Early groups such as the 97th BG were in combat within four months of activation.

With due pomp and ceremony, a B-17 group prepares for the first stage of its move overseas, a journey which could take around a month if the assignment was Europe. The ground echelon (maintenance, supply and headquarters staff) sometimes left a day or two before the air echelon for a sea crossing, and sometimes after, timing their arrival at the UK station a few days before the bombers arrived. The aircrews flew by either a northern route via Greenland and Iceland, or a southern one via Brazil and the Azores, depending on the season.

to be shot down in aerial combat.

The story of Captain Colin Kelley and his last flight was blown out of proportion by the media in the United States, but his accomplishment and sacrifice gave the United States a hero when it desperately needed one, as the Japanese juggernaut rolled on.

Last of the shark-finned Forts

The Boeing B-17Cs and Ds did yeoman duty in the southwest Pacific in the Philippines and Java, before the survivors retreated to Australia. They performed well under very trying conditions and their only real weakness was the absence of any guns in the tail, a shortcoming that was rectified in the Boeing B-17E.

The only survivor of the early B-17Cs and Ds was B-17D 40-3097, which was actually composed of parts from various wrecks put together to make one flyable aircraft. The half-swan/half-goose gained the name of 'The Swoose' and wound up in Australia, where it became the personal transport of Lieutenant General George H. Brett until the end of the war.

The revolutionary 'E' model

With the fall of France in June 1940, the production of warplanes became critical and the need for a large bomber became crucial. Boeing submitted a bid to the US War Department in early August 1940 for the production of 512 improved B-17s, but was told that the price was unacceptable. After much haggling over price a contract was drawn up for 277 aircraft, designated B-17E, with serial numbers 41-2393 through 41-2669. Change Order No. 1 brought a contract for an additional 235 B-17Es, serial numbers 41-9011 through 41-9245.

The B-17E incorporated many changes in the basic aircraft. The entire fuselage behind the radio room was redesigned, becoming larger and straighter. Weight increases in the aircraft made changes necessary on the horizontal stabiliser, which was increased from 33 ft 9 in (10.29 m) to 43 ft (13.11 m). The dorsal fin and rudder were completely new, being much larger, with the fin extending almost to the radio room hatch. The rear of the fuselage was extended nearly 6 ft (1.8 m) to accommodate the installation of the tail gunner's compartment, which housed the gunner, twin 0.50-in machine-guns and ammunition boxes.

A power turret with two 0.50-in machine-guns and a Sperry computing sight was mounted just aft of the flight deck, and a remotely controlled turret equipped with two 0.50-in machine-guns was fitted in the belly of the fuselage aft of the radio room. This belly turret proved to be inadequate and was replaced with the manned Sperry ball power turret with two 0.50-in machine-guns from the 113th B-17E (41-2505).

Production problems

A 0.50-in machine-gun was mounted in each of the new rectangular waist windows in the rear of the fuselage. A 0.50-in gun firing from the radio hatch was retained, as was one 0.30-in machine-gun in the nose. Once the aircraft had been delivered to the units, many field modifications were made to the installation of guns in the nose.

The B-17E had new, modified Wright R-1820-65 engines which developed 1,000 hp (750 kW) at 2,300 rpm at 25,000 ft (7620 m). This engine proved to be one of the most dependable powerplants utilised by the US Army Air Force during World War II.

Production of the B-17E was delayed by a shortage of materials. The enormous build-up of armed forces in the United States, coupled with the demand for military supplies for Great Britain, meant that all wartime plants were screaming for materials to produce their products. Boeing finally had to send an ultimatum to the War Department stating that there would be undue delays in the production of the B-17E unless they were given a priority on aluminium. The contract date for the first B-17E was 30 April 1941, but the first B-17E actually came off the production line on 27 September 1941.

The first Boeing B-17Es arrived in the Pacific war zone on 14 January 1942. They began to supplement the worn B-17Ds and a very few B-17Cs that had survived operations in the Philippines. The Flying Fortress equipped the 19th Bombardment Group and the newly arrived 7th Bombardment Group, which carried out their missions from Java and then Australia against the Japanese invasions

Below: B-17Es of an unidentified group are seen in the US. Note that* Yankee *retains the central red spot in the insignia, but that the aircraft behind does not, dating this scene to sometime soon after May 1942.

of the Dutch East Indies and New Guinea. With a handful of B-17s, these units did their utmost to carry the war to the enemy as best they could with few supplies and limited manpower.

First Fortress Medal of Honor

The first Medal of Honor to be won by a Boeing Flying Fortress crew member resulted from an action that took place on 17 August 1942. Captain Harl Pease flew B-17E 41-2429, which was plagued by electrical problems and weak engines, on a six-aircraft mission from New Guinea to the Japanese stronghold at Rabaul, New Britain. The bomb run was made in unlimited-visibility weather and lasted 15 minutes. Shortly after bombs away at 11.45, the formation was intercepted by 20 'Zero' fighters.

The Fortresses headed for the clouds but the 'Zeros' were all over them. Although most of the B-17s reached cloud cover within 20 minutes, the aircraft flown by Captain Pease lagged behind. His aircraft was last seen after it dropped its flaming bomb bay fuel tank, descending with both inboard engines on fire. There were reports of two parachutes being seen, but the official report stated that the aircraft crashed in flames and all were lost.

Years later it was learned that Captain Pease and one of his gunners, Sergeant Czehowski, did manage to parachute and were taken prisoner. The men remained prisoners of war at Rabaul until 8 October 1942, at which time they and four other prisoners were taken from the compound and executed by the Japanese.

Pacific summary

Five bombardment groups of the USAAF operated B-17s in the Pacific. The 19th, which was in the Philippines at the start of the conflict, continued to operate under extremely trying conditions in the Philippines until the islands fell in April 1942. Then the B-17s flew missions in support of Java until it, too, fell to the Japanese. The few survivors and their aircraft next went to Australia, where they continued to operate until they were relieved in the summer of 1942.

Into battle

The 7th Bombardment Group was en route to the Pacific in its B-17s when some of its aircraft were caught in the air during the attack on Pearl Harbor. The Fortresses continued to Australia, where they operated against the enemy in Java in early 1942. The group then proceeded to India to become a B-24 unit.

The 11th Bomb Group and its B-17s arrived in the New Hebrides Islands in July 1942. From there they struck at

Some of the first B-17s in Europe, such as these of the 401st BS, 91st BG, had medium green blotching applied to the olive drab top surfaces. This was added as a protective measure against the perceived threat of Luftwaffe air attack on 8th AF bases, as the camouflage broke up the outline of the aircraft seen against grass airfields.

Far left: This B-17F of the 388th BG at Knettishall was named for one-time resident of nearby Thetford, philosopher and American revolutionary Thomas Paine.

Left:* Idiot's Delight *of the 94th BG was the first aircraft of its group to complete 50 missions without a turnback.

B-17F

As it rolled off the production line, the B-17F differed little externally from the B-17E, the main visual difference being the replacement of the framed nose-piece by a multi-part clear-blown Plexiglass dome. Paddle-bladed propellers with slightly altered cowls (to allow feathering) were another, less obvious, recognition feature. More than 400 detail changes from the E were incorporated.

Above: An anonymous early B-17F in the US is seen in early 1942. The red spot in the insignia would have been removed on delivery to the army and a serial added. Generally, the correct basic markings were applied by the manufacturer to government specifications. Originally, the B-17F was ordered under the B-17E contract and B-17Es were sent to Lockheed/Vega and Douglas as patterns for pool production. In the event, the first aircraft produced by the B.V.D. pool were Fs.

Right: This view of a B-17F on a test flight shows the lack of forward firepower of this model as delivered, and therefore its weak spot in combat. Future external changes to the B-17 were mostly related to correcting this fault.

Japanese shipping in the Solomon Islands, as well as island targets. They returned to Hawaii in summer 1943 to convert to B-24s.

The 5th Bomb Group moved into Espiritu Santo in December 1942 to begin its B-17 operations against the Japanese. They flew many missions against enemy shipping and island targets in the northern Solomon Islands. The 5th re-equipped with B-24s during August-December 1943.

The 43rd Bomb Group and its Fortresses arrived in Australia in March 1942 and later flew from New Guinea and Owi Island. They took part in the Battle of the Bismarck Sea and struck at many targets in the Solomon Islands. The 43rd converted to B-24s during late summer 1943.

The switch from B-17s to B-24s in the Pacific was a result of high-level agreements between the United States and Great Britain, which decreed that the European Theatre of Operations would have priority for men and materials until Germany was defeated. The 8th Air Force, which was determined to prove its case for daylight bombing, wanted all of the B-17s it could get its hands on. General Ira Eaker had been one of the champions of the

In the US, aircraft names tended to be patriotic such as* Avenger *or* Yankee. *The experience of combat operations and the army way of doing things led to some definitely unofficial and more ambivalent nicknames, such as* SNAFU, *which was a B-17F of the 332 BS, 94th BG. Note the grey codes and toned-down insignia.

Thirty-two year old S/Sgt Maynard 'Snuffy' Smith was on his first mission when flak ripped through his 306th BG Fortress over the Brest Peninsula, 1 May 1943. Ball-gunner Smith fought the fires, tended his wounded colleagues and fought off attacking Fw 190s with the waist guns. As the B-17 crossed the Channel, Smith threw out surplus equipment to help the pilot get home. For his heroism, Smith received the second Medal of Honor to go to a member of the 8th AF. One of the crew, Bob McCullum, here inspects the damage to his aircraft, which never flew again.

B-17 since peacetime and it was only natural for him to believe that the Flying Fortress was the aircraft that could achieve his goals.

Fort vs Lib: Pacific

The B-24's slightly longer range was useful in the Pacific, and tight formation was not a requirement for that theatre. By and large, the men in the Pacific were pleased with the B-24 and the job it was able to accomplish.

There were two more Medals of Honor awarded to B-17 crew in the Pacific. Major Jay Zeamer of the 43rd Bomb Group and his crew volunteered to fly a long-range photographic mission to Beka airdrome on 16 June 1943. During the mission they encountered many determined enemy aircraft. Although badly wounded, Zeamer was able to bring his crippled B-17 home. His bombardier, Lieutenant Joseph Sarnoski, fought off concentrated fighter attacks after dropping his bombs and, although repeatedly wounded by enemy fire, remained at his guns until he died. Both Zeamer and Sarnoski were awarded their nation's highest award.

The mission to Marienburg on 9 October 1943 was held up as a shining example of precision bombing. All but nine of the aircraft in five groups dispatched (including the 94th BG seen here) bombed effectively and inflicted severe damage on the Focke-Wulf factory. Only two aircraft were lost. Rarely, however, were such clear-cut successes achieved for such little cost.

Fortresses to England

During the summer of 1942 the first American Boeing B-17Es arrived in England with the 8th Air Force. On 17 August 1942, 12 B-17Es of the 97th Bombardment Group set out from England to strike the marshalling yards at Rouen, France. This marked the first heavy bomber mission by the 8th Air Force. Packed in the bomb bays were 45 600-lb (272-kg) and nine 1,100-lb (498-kg)

Short-range missions, such as number 38 against U-boat pens at Brest on 27 February 1943, were the origin of the expression 'milk run'. Forty-six B-17s and 14 B-24s attacked from high altitude in perfect visibility, with the losses of two Liberators and no Fortresses. Unfortunately, the target was undamaged due to poor aiming. Seen leaving the target and heading home is **FDR's Potato Peeler Kids** *of the 303rd or 306th BG.*

Famous Fs

After nearly a year of combat in Europe, most of the original B-17s in the theatre had been lost or scrapped. The US press, hungry for evidence of the success of the bombing campaign, latched on to those aircraft and crews which approached or achieved milestone mission totals of 25 and 50. After the first of these had been sent home and the publicity machine moved on, dozens of B-17s were to complete over 100 missions with little fanfare.

The pilot of **Memphis Belle,** *Robert Morgan, accepts the congratulations of Lt Gen. Jacob Devers and Maj. Gen. Ira Eaker after the completion of his crew's and his aircraft's tour of duty, at that time 25 missions.*

Above: The first pilot in the **ETO** *to complete 30 missions was Major Lewis Lyle. He later went on to command the* **379th BG** *at Kimbolton from October 1944 until the war's end, helping contribute to the group's reputation as the most accurate and most reliable in the 8th Air Force.*

Right: The most famous of all Fortresses, the **Memphis Belle,** *was sent back to the US for a war bond tour. Not the first B-17 to complete 25 missions, but the first in the 8th AF to return home after doing so,* **Memphis Belle's** *fame has much to do with the wartime documentary of the same name. She is preserved to this day in Memphis.*

Above: The first B-17 in the **ETO** *to actually complete 25 missions was* **Hell's Angels** *of the 303rd* **BG** *(who were also nicknamed the 'Hell's Angels'). This milestone occurred on 14 May 1943, three days before the* **Memphis Belle's** *25th. The aircraft was signed by unit personnel before returning to the* **US** *for a bond tour.*

An infamous Fort was **Tinker Toy** *of the 535th* **BS,** *381st* **BG.** *The bomber gained something of a reputation as a 'jinx ship', with three crew members killed and a number wounded during its career of just less than six months. On 20 December 1943,* **Tinker Toy** *collided with a German fighter and went down with all but three of its crew.*

Above: Another famous 303rd Group aircraft, which achieved the significant double of first in the **ETO** *to 50 and 75 missions was* **Knockout Dropper** *of the 359th* **BS.** *The 50th mission came on 16 November 1943 and the 75th on 27 March 1944, after which it returned to the* **US** *for the customary bond tour.*

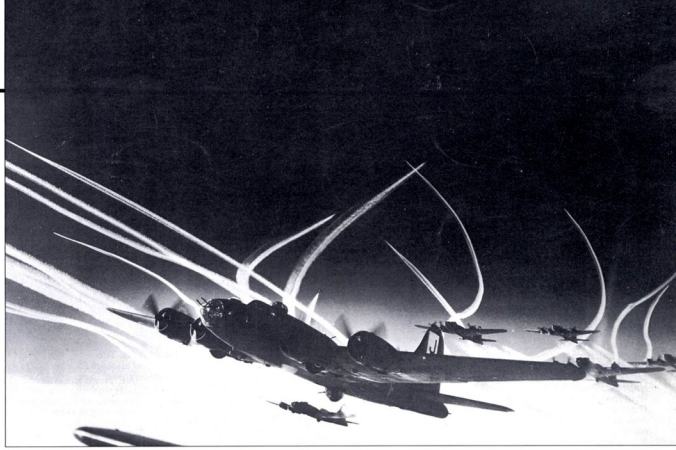
bombs. A few of the bombs fell short of the target, but most smashed into the assigned area.

Major General Ira C. Eaker, Commander of Eighth Bomber Command, flew as an observer in the lead aircraft. Piloting the lead B-17 was Major Paul Tibbets, who would later pilot the B-29 that dropped the first atomic bomb over Hiroshima, Japan.

RAF B-17Es

Although it had been disappointed with the B-17C, the Royal Air Force acquired 45 B-17Es through Lend-Lease. The aircraft were known as Fortress IIs and had serial numbers FK184/213, FL449/460 and FL462/464. The aircraft began to arrive in March 1942.

US Air Force commanders were taken aback when they arrived in England in April 1942 and read the Royal Air Force assessment of the B-17E regarding its daylight bombing roll. The British experts who examined the B-17E were of the opinion that "(a) defensive fire power is too weak to afford reasonable protection, the tail gun being cramped and the belly turret so awkward as to be useless." They stated that they would remove it and use the aircraft with Coastal Command. The report continued: "(b) 4,000-lb bombs cannot be installed and bomb loads in any case are small unless the bomb bay fuel tanks are removed, at the expense of range."



With fighters weaving overhead, 390th BG B-17Fs plough on towards Germany. Contrails were a telltale sign of a bomber formation's position, but could disappear with a change in altitude of a few hundred feet. It was usually regarded as too difficult to make a whole combat box formation of several groups climb or descend, so squadrons stuck to their assigned altitudes and hoped the fighters would pick on someone else.

True to its word, the RAF relegated the Boeing B-17E to Coastal Command from August 1942, where it served for some time.

Pool production

The B-17F was the first model of the Flying Fortress to be assembled by the so-called B.V.D. pool. These letters stood for three manufacturers at different locations, which between them built a total of 3,405 B-17Fs: Boeing at Seattle, Washington, which built 2,300; Lockheed/Vega at Burbank, California, which turned out 500; and Douglas at Long Beach, California, which built 605.

The B-17F went through a myriad of modifications during its production, and to indicate these differences different block numbers were set up in multiples of five. For instance, Boeing produced a B-17F-5 followed by a B-17-10, -15, etc. The block number for specific modifications did not match from one manufacturer to another. Boeing block numbers went to -130, Vega to -50 and Douglas to -80. In order to identify the aircraft by manufacturer, they carried a suffix of BO for Boeing, DL for Douglas and VE for Vega.

The Army Air Force serial numbers for the B-17Fs were as follows: B-17F-BO – 41-24340 through 41-24639, 42-5050 through 42-5484, 42-29467 through 42-31031; B-17F-VE – 42-5705 through 42-6204; B-17F-DL – 42-2964 through 42-3562, 42-37714 through 42-37715, 42-37717 through 42-37720.

One distinctive feature of the new B-17F was the one-piece moulded clear plastic nosecone, which used no metal support members. Also in the nose were a number of different armament features. Fittings for 0.50-in guns were mounted in Plexiglass cut-outs staggered on either side of the nose. The 0.30-in machine-gun was originally left in the nose for the bombardier, but was later replaced with a 0.50-in gun. By the end of the war, every kind of nose gun modification imaginable could be found, from twin 0.50-in guns to fixed 0.50-in guns that the pilot could fire. All this was brought about by the determined Luftwaffe attacks over Europe, aimed directly at the weakest armament point on the Boeing B-17.

Of great importance to the B-17F was the installation of fuel tanks in the outer wing panels. These 'Tokyo tanks', as they were called, carried an additional 1,100 US gal (4165 litres) of fuel.

Very few Boeing B-17Fs ever went to the Pacific. Most of them were rushed to England where they replaced the B-17Es serving with the initial bomb groups in the 8th Air

Clear weather gave good visual bombing results, but equally offered a good target for the enemy gunners. As these 390th BG B-17Fs drop on the leader's signal, flak has got their altitude within a few feet. The target was Amiens/Glisy airfield in France.

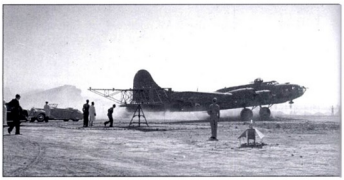
Below: 'If the flak doesn't get you, the fighters will' was a maxim in the ETO. If the fighters were flown by the likes of Egon Mayer, Kommodore of JG 2, the odds were stacked even further against the B-17 crews. This B-17F of the 94th BG, down in a French field on 14 July 1943, was one of 25 four-engined bombers destroyed by Mayer.

Africa

With no chance of an Allied landing on the European mainland in 1942, attention turned to driving the Axis forces from North Africa. In preparation for the landings, codenamed Operation Torch, the 12th Air Force was formed in the US. Entirely a paper organisation until its move to the UK in August, the new air force set about creating a nucleus of a strategic bomber force by taking over the 97th and 301st BGs already established there. These two groups moved to Algeria via Gibraltar at the time of the Torch landings in November, and were followed in the next few months by the 99th and 2nd BGs which had formed in the US. Together they formed the North African Strategic Air Force (NASAF) as part of Mediterranean Air Command (MAC). The four groups took part in the Allied drive across North Africa, being regarded as instrumental in the surrender without ground fighting of the last Axis stronghold on Africa at Pantelleria in June 1943. With North Africa secured, the heavy bombers were able to concentrate on softening up defences in southern Italy (particularly airfields) in preparation for the landings on Sicily. After Allied forces secured a foothold in Italy in the autumn of 1943, 12th Bomber Command was re-established there in December.

Above: A B-17F of the 2nd BG undergoes repair (or cannibalisation) in the field. The bars under the serial indicate an aircraft of the 20th BS. The tailwheel appears to have collapsed.

Above: The crew of **Trouble Shooter** *of the 97th BG, Telergma, Algeria is seen in August 1943. Little manpower or support equipment was available in Africa and the aircrews had to pitch in with bomb loading and basic maintenance.*



Above: A B-17F raises dust and a fair deal of local interest on take-off from a North African field. Take-offs on these unprepared airfields had to be carefully spaced to keep blowing sands away from the following aircraft.

Right: The B-17s that took part in Operation Torch had no particular identifying markings other than the yellow-ringed national insignia. With four groups in theatre by spring 1943, a new marking system using geometric symbols was developed; a square identified the 301st BG.

Right: The first B-17s in Africa were part of the Brereton Detachment sent from the 10th AF in India to bolster British forces during Rommel's summer 1942 drive on Suez. General Lewis Brereton gathered together all available heavy bombers, including B-17E **Esmerelda** *(seen earlier), and was able to mount small but morale-boosting raids from June until the arrival of B-24s in Egypt at the end of July brought the available bombing force to significant levels.*

Force. The B-17F absorbed the majority of the punishment in the many air battles that took place from late 1942 until the B-17G began to replace it in September 1943. The F model was the prominent Army Air Force bomber in the Mediterranean following the invasion of North Africa in November 1942. The Flying Fortresses from the 97th and 301st Bombardment Groups came from England shortly after the invasion to take up the heavy bombing duties of the 12th Air Force, and were joined in the spring of 1943 by the 2nd and 99th Bombardment Groups equipped with B-17Fs.

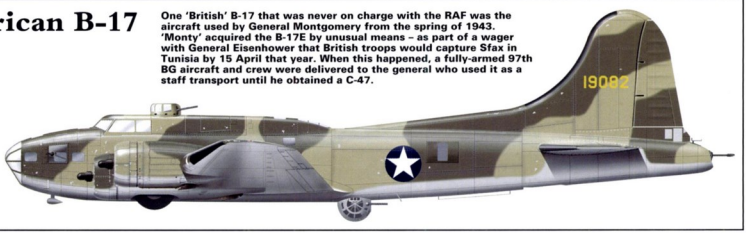
The vicious air battles with the Luftwaffe over northern Europe brought many armament modifications to the Boeing B-17Fs. In the attempt to prove that daylight bombing over Europe could be successful, the 8th Air Force was determined that the bombers be able to fight off Luftwaffe attacks unescorted. Head-on fighter attacks against the bomber formations presented problems, though, and additional increases in armament throughout the aircraft came under consideration.

YB-40: fighter Fortress

The initial attempt to increase the firepower of the B-17F was undertaken by Vega on 41-24341. The aircraft was designated XB-40 and the primary changes consisted of the installation of two additional power turrets. The first

African B-17

One 'British' B-17 that was never on charge with the RAF was the aircraft used by General Montgomery from the spring of 1943. 'Monty' acquired the B-17E by unusual means – as part of a wager with General Eisenhower that British troops would capture Sfax in Tunisia by 15 April that year. When this happened, a fully-armed 97th BG aircraft and crew were delivered to the general who used it as a staff transport until he obtained a C-47.



The port of Messina on the northwest tip of Sicily came in for particularly heavy assault by the B-17s of the 12th AF. On 25 June 1943, all four groups bombed this strategically vital target. This is a 414th BS, 97th BG aircraft on an earlier raid.

was a twin 0.50-in machine-gun turret on top of the fuselage in the radio room. The second was a new remotely controlled two 0.50-in gun 'chin' turret mounted directly below the nose of the aircraft. Waist gun positions became two installations with power boosts, and the tail guns were also power boosted.

The ammunition load for the XB-40 totalled 11,135 rounds of 0.50-in ammunition, compared to the normal 0.30-in and 0.50-in machine-gun load of the B-17F of 3,400 rounds. For short-range missions the load could be increased to 17,265 rounds. The aircraft was not to be considered a bomber but it could still carry a light load on shorter missions. However, the 11,135-round load pushed the gross weight of the aircraft from a normal weight of 40,260 lb to 58,000 lb (18260 kg to 26310 kg).

The XB-40 was tested at Wright Field. A number of aircraft were subsequently modified to that configuration, to be designated YB-40. A total of 23 YB-40s was ordered but only 19 were delivered. Although the aircraft were identified as Vegas, the conversion of the B-17F-10-VEs was done by Douglas at its Tulsa, Oklahoma plant, with the first models appearing in February 1943.

On most missions the Africa-based B-17s faced a longer overwater journey to their targets than their England-based counterparts. The 12th AF adopted a looser formation for heavy bombers, based on vics of three, than did the 8th.

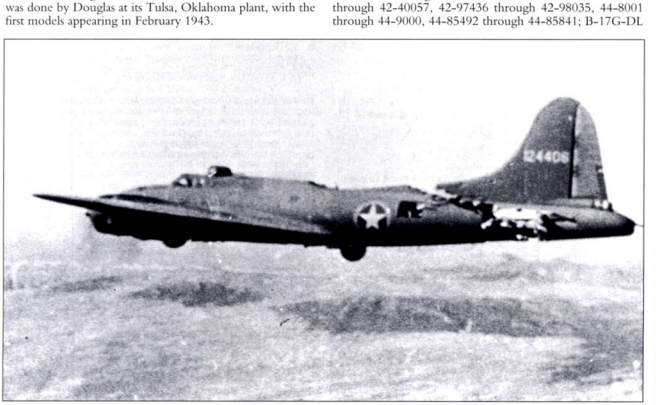
The serial numbers on the YB-40s were 42-5732/5744, 42-5871, 42-5920, 42-5921, 42-5923/5925, and 42-5927.

The YB-40s were dispatched to England where they were assigned to the 92nd Bombardment Group of the 8th Air Force. They became operational in May 1943 and at times two or more of the Fortresses were sent to various other bomb groups for utilisation.

The heavy load of the YB-40 proved to a disadvantage from the start. When the normal bomb-laden aircraft dropped their bombs, they immediately were able to gain altitude and speed to get out of the target area. The YB-40 was still laden with its dead weight and it was impossible for them to keep up. This forced the unladen B-17s to throttle back and allow the slower YB-40s to stay with the formation. By August 1943 the YB-40s had been withdrawn from combat.

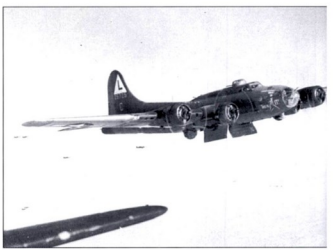
B-17G

The Boeing B-17G was built in very large numbers: 4,035 by Boeing, 2,395 by Douglas and 2,250 by Lockheed/Vega, for a total of 8,680. Serial numbers were: B-17G-BO – 42-31032 through 42-32116, 42-97058 through 42-97407, 42-102379 through 42-102978, 43-37509 through 43-39508; B-17G-VE – 42-39758 through 42-40057, 42-97436 through 42-98035, 44-8001 through 44-9000, 44-85492 through 44-85841; B-17G-DL



One of the most remarkable testimonies to the strength of the B-17 design is the story of All American *of the 414th BS, 97th BG. Flying a mission against Tunis on 1 February 1943,* All American *was struck by a Bf 109 flown by 16-victory ace Erich Paczia of I/JG 53, who had probably been killed before impact. The tail section was almost severed and one horizontal stabilator was lost completely. The tail gunner crawled forward and joined the rest of the crew for an eventual safe landing at Biskra, shortly after which the tail finally gave way. The B-17F was given a new tail and flew on, mainly as a 'hack' aircraft, until March 1945. The 414th BS adopted a version of this image with a praying puppy atop the rear fuselage as a unit badge.*

Through a darkening sky, a loose formation of B-17Fs returns from a mission over the continent. Missions could last 10 hours or more, with take-off and landing in darkness during the winter months. Many crews survived flak and fighters only to crash on landing or, on occasion, fall victim to Luftwaffe intruders in the airfield circuit.



Above: Rarely did the name of a bomber seem more apposite than in this image of* This is It! *of the 381st BG about to rearrange part of Hitler's Germany in late 1943.

– 42-3563, 42-37716, 42-37712 through 42-38213, 42-106984 through 42-107233, 44-6001 through 44-7000, 44-83236 through 44-83885.

The most significant difference in the B-17G was the installation of the chin turret on the nose. Some of the first B-17Gs had this turret installed at modification centres rather than at the factory. The chin turret was operated remotely by the bombardier. Nose panels for mounting guns on either side of the nose were the same as those installed on late model B-17Fs.

The installation of staggered waist windows enclosed with Plexiglass did not start at the beginning of production. A number of B-17Gs were fitted with the permanently closed waist window with three transparent panels and the waist gun installed on the window sill. On the later B-17Gs the gun was installed on the lower sill.

Later radio room gun installations on the B-17G used an enclosed transparent panel over the radio room with provision for the customary 0.50-in gun. Very late B-17s did not incorporate a gun installation on the radio room hatch at all. This gun had always been considered the less useful gun on the B-17, so it was finally eliminated.

At around the mid-point of B-17G production, the aircraft began to receive new tail gun installations at the United Air Lines modification centre at Cheyenne, Wyoming. This prompted the nomenclature 'Cheyenne Tail'.

The new twin 0.50-in gun installation increased the elevation and azimuth capability of the guns. The old ring-and-post-type gun sight was replaced with a more accurate reflector sight. Larger windows increased visibility, and the total installation decreased the length of the fuselage by 5 in (13 cm). Many earlier B-17Gs received the 'Cheyenne Tail' modification at centres in England.

Both the B-17F and B-17G flew with Wright R-1820-97 engines capable of 1,200 hp (900 kW) on take-off. Maximum speed was between 302 and 315 mph (486 and 506 km/h), and cruising speed was approximately 160 mph (260 km/h) at 5,000 ft (1525 m). The installation of 'Tokyo' fuel tanks on both models increased the fuel capacity to 3,600 US gal (13630 litres) and increased the normal range of the aircraft to 3,750 miles (6035 km).

Royal Air Force B-17Gs

The Royal Air Force obtained 85 B-17Gs, designated Fortress Mk IIIs. Thirty came from Boeing and the rest from Lockheed/Vega, all used by Coastal and Bomber Commands. The Fortress IIIs operated by Coastal Command were used as anti-U-boat aircraft. They could carry up to 12 400-lb bombs or 16 250-lb charges, and in place of the ball turret they carried search radar in that position. Bomber Command Fortress IIIs were fitted with extensive radar and countermeasures equipment. Some were employed as pathfinder aircraft and others dispensed

One of the most unusual modifications to nose armament was this seen on* The Last Straw, *which may be a B-17F with a modified B-17E nose piece. Twin guns have been fitted through a removed panel sealed with canvas. The guns were aimed through a dome fitted to the nose roof window, theoretically leaving the bombsight accessible.

Below: Improvised cheek guns as seen on* Miami Clipper *were superseded by depot-installed angled windows that gave some forward view. Later these were introduced on production aircraft.

'chaff', the many tin foil strips used to jam German radar sets.

Royal Air Force serial numbers for the Fortress Mk IIIs were HB761/782, HB783/788, HB789/790 from Boeing; HB791/793, HB795/796, HB799/803, HB805, HB815/820, KH998/999, KJ100/102, KJ103/110, KJIII/115, KJ116/125, KJ126/127, KL830/832, KL833/837 from Vega.

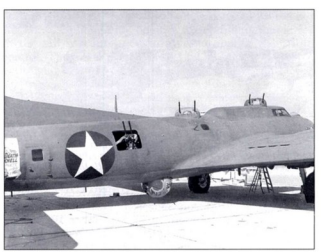
Radar and countermeasures

Weather proved to be a great obstacle during early operations with the 8th Air Force and many missions were cancelled due to clouds over the target areas in Europe. The Royal Air Force was considering this problem when the USAAF arrived in England, so it was only natural that they joined forces in March 1943.

Several USAAF radio mechanics were attached to the Royal Air Force to learn about the radar equipment. In the same month, a B-17F from the 92nd Bombardment Group was sent to RAF Defford to have one of the H2S sets installed. It was first thought that the radar scanner could be located in the ball turret position, but 8th Air Force Commander, General Ira Eaker, did not want to lose the armament position so the set was installed below the nose of the Fortress, where it was shielded by a plastic bathtub-like cover. Many difficulties were encountered but, regardless, more B-17Fs were modified.

YB-40 Gunships

The lack of an escort fighter able to shepherd the heavy bombers to the most important German industrial targets, and the adoption by the Luftwaffe of head-on attack tactics, led to a number of projects to improve fighter defence for the B-17 and B-24. These ideas came together in the YB-40 gunship programme, which began as a request for studies into a 'convoy-protector' aircraft as early as April 1942, before the B-17 had even entered combat in Europe. By September, the prototype XB-40, a Boeing-built B-17F-1 modified by Lockheed-Vega, was complete. Subsequent YB-40s were converted by Douglas at Tulsa, Oklahoma. The most striking changes were the addition of a Bendix chin turret and a Martin turret in the radio room position. Waist armament was doubled to four hydraulically-boosted 0.50-in guns, and boosted guns were fitted in the tail position. Additional armour plate was added around the engines and crew positions. Ammunition supply was tripled to 10,700 rounds. After testing, it was decided to offset or 'stagger' the waist windows to allow the gunners more room to manoeuvre. Thirteen of the YB-40s were sent to the 327th BS, 92nd BG at Alconbury for testing in a combat environment in April 1943. The combat evaluation programme was not successful. In addition to a large number of material defects and technical faults, the YB-40s were found to be unable to keep up with the bomber formation after bomb release due to the additional weight of guns, ammunition and armour. Only one inconclusive fighter attack was recorded on a YB-40 and the programme was cancelled in July. Commanders and crews, however, had much praise for some features of the gunship design, especially the chin turret and staggered waist windows, and these features eventually found their way onto B-17 production aircraft.



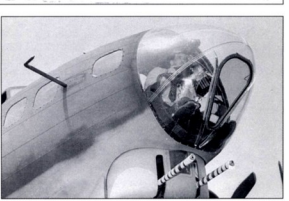
Above: A 305th BG B-17F flies high above snowy fields. This unnamed but battle-worn Fortress has a twin-gun arrangement in the nose.

Left: This view shows the firepower that could be brought to bear by a B-40 against a beam attacker. However, few attacks were made from this direction in actual combat.

Below: The XB-40 had non-staggered waist gun positions. The conversion was by Vega but the YBs were Douglas-modified.

Right: The Bendix chin turret was the most useful result of the XB/YB-40 project. The turret on 'fighter Fortresses' had a forward sighting window unlike that fitted to late B-17Fs and to B-17Gs.

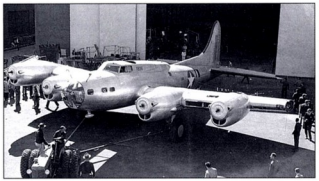
Left: After the failure of the B-40 project, the surviving aircraft – one was lost in combat with the 92nd BG – returned to the US. There they joined others that were never delivered to combat units and were integrated into training units as TB-40s.



XB-38

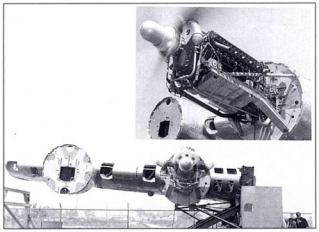
The new partners in B-17 production brought with them a number of their own proposals for improving the basic design. Most of these involved modifications to the basic armament, but the most radical to reach the hardware stage was Vega's re-engined XB-38. The ninth B-17E (41-2401) had been allotted to Vega to study as part of the build-up to pool production and this aircraft was assigned to Vega project V-134-1, Army designation XB-38. The one aircraft completed remained mostly B-17E apart from the smoothly-cowled V-1710-89 inline engines, and other modifications to the wing including Lockheed-designed auxiliary fuel tanks of 1,080-US gal (4088-litre) capacity. Only one of the three XB-38s ordered ever flew and this was lost following an inflight fire on 16 June 1943. Deciding that it could better use the Allison engines on P-38s and P-40s, the Army cancelled the XB-38 on 12 August.

The first production B-17s to sport chin turrets for forward defence were B-17F-75-DLs, of which 59 were built. Some Vega B-17Fs also had chin turrets. This aircraft of the 94th BG, seen taking off from Mount Farm, is actually a B-17F-70-DL with a depot-installed turret.



Above: The XB-38 first flew on 19 May 1943. At its roll-out, it had yet to be fitted with its new propellers which were 7 in (18 cm) longer than the standard B-17E items.

The XB-38 proved slightly faster and considerably longer-ranged than the B-17F, but had a much lower service ceiling. After only 12 flight hours it crashed near Tipton, California.



Vega skilfully engineered the mounts for the Allison V-1710s so that they fitted onto the original firewalls. The cooling radiators were fitted into the wing leading edges and the oil cooler intakes moved from there to beneath the spinners.

By September, four modified B-17Fs were assigned to the 813th Bombardment Squadron. These Fortresses flew their first combat mission on 27 September 1943. They continued to operate, but radar difficulties forced them to yield their position as PFF lead aircraft when H2X radar-equipped B-17s became available in November 1943.

The Massachusetts Institute of Technology was the US government's agency in radar research, and it assembled sets based on the British H2S system and adapted them for use by the USAAF. These sets became known as H2X and were fitted under semi-retractable domes under the noses of 12 B-17s at Rome Air Depot, New York. The aircraft were delivered to the 8th Air Force in England and became the pioneers in AAF Pathfinder operations, undertaking their first operation in November 1943. The H2X set became known as 'Mickey'. Additional H2X-equipped B-17s did not arrive in England until January 1944, and when they did they sported a significant change: the radar set was positioned where the ball turret had been. 'Mickey' sets were also in use with the 15th AF in Italy by spring 1944.

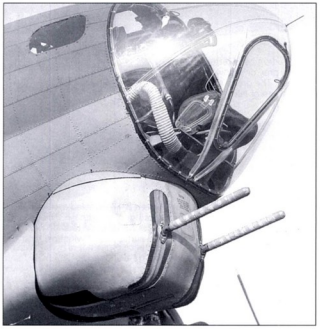
The most common radar countermeasure used by the crews of the B-17 was the dispensing of chaff, or 'window' as it was also known. These were strips of tin foil, which were almost identical to what was hung on Christmas trees as icicles. The metal strips gave the same return on radar screens as aircraft. When bundles of them hit the air, they produced so many radar images that in some cases the screens were almost blotted out.

Chaff was first used by the Eighth Air Force on 22 December 1943, and it continued to be used throughout the war even though the German defences developed some means to counteract it. The strips were also used in great quantity by the 15th Air Force in Italy. Some units used metal chutes as chaff dispensers, and others issued the foil strips to crew members – usually waist gunners – to dispense manually. An updraft in the rear of the aircraft could result in chaff-festooned gunners.

Special weapons

A limited number of special weapons were employed by B-17 crews during World War II. One was the VB-1 Azon bomb, consisting of a special tail unit fitted to a standard 1,000-lb bomb. A transmitter in the aircraft guided the azimuth course of the bomb through a receiver in the unit. Azon was used by specially trained crews of the 301st

Above: A shiny new B-17G-BO wheels over Puget Sound. B-17Gs were produced as a continuation of B-17F production although they incorporated many changes other than the chin turret, one of the most important being new electric turbocharger regulators.



The Bendix chin turret was the outstanding new feature of the B-17G. As well as providing effective forward defence, the turret brought the centre of gravity further forward, reducing tail-heaviness. B-17G s had several variations in the nosepiece depending on manufacturer and block .

A Douglas-built B-17G or late B-17F makes a low run along the Santa Monica runway. The B-17F-75s built by Douglas were later redesignated B-17G-1s.

Bomb Group of the 15th AF in Italy. The weapon was used many times between April and July 1944 but it was decided that the release altitudes of the bomb were too high and the accuracy of the bomb was little better than the standard bomb trajectory.

The GB-1 glide bomb, a 2,000-lb bomb with 12-ft (3.6-m) glider wings and a tail unit, was tested by the 8th Air Force. Although the bomb was free-falling, the device in the tail was intended to give automatic stabilising control. The GB-1 was not successful. A later model GB-4 with radio-controlled flight surfaces and a TV camera was also tested, but only a few sorties were flown.

B-17s from the 8th AF did drop a number of 4,500-lb Disney rocket bombs. These bombs free-fell until they reached 5,000 ft (1525 m), at which time a rocket motor kicked in and propelled the missile. Used against U-boat pens, the bombs penetrated up to 20 ft (6 m) before detonation.

Eighth Air Force B-17s

From a small nucleus of B-17Es in England, Eighth Air Force grew to three air divisions. Two of these divisions were composed of B-17 Flying Fortresses and the third of B-24 Liberator units. Of the two original B-17 units in the Eighth Air Force, the 97th Bombardment Group – which flew the first heavy bomb mission from England – and its sister group, the 301st BG, moved to North Africa in November 1942 following the invasion of that continent. Other units continued to join the remaining groups of B-17s. Initial targets were in the occupied countries, particularly the U-boat pens in France. Fighter opposition was initially light, but as the numbers of bombers grew so did the number of intercepting fighters. The Fortresses began to suffer losses.

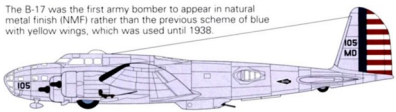
Captured B-17G

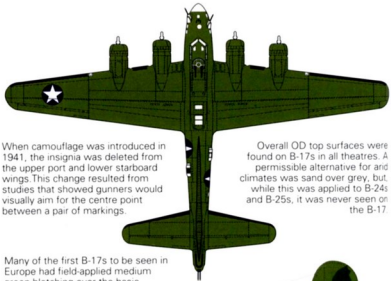
On 3 March 1944, B-17G-25-DL 'XR-O' of the 349th BS, 100th BG found itself one of only three 8th AF B-17s over Germany, when its crew failed to receive the signal that the mission was being recalled due to bad weather. Fighters attacked, destroying the other two B-17s and damaging 'XR-O'. Pilot 1st Lt John Gossage set course for Sweden but put down on Schleswig-Jagel in Germany in the belief that they were in neutral territory. The completely intact B-17 was assigned to German clandestine unit I/KG 200 and took part (with two other B-17s at around this time) in agent-dropping and other secret missions as far apart as the USSR, Algeria and Ireland.

Boeing B-17 Colours

US Army Air Forces/US Air Force

The B-17 was the first army bomber to appear in natural metal finish (NMF) rather than the previous scheme of blue with yellow wings, which was used until 1938.

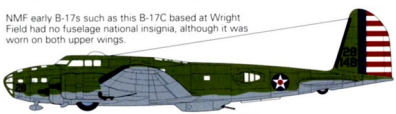




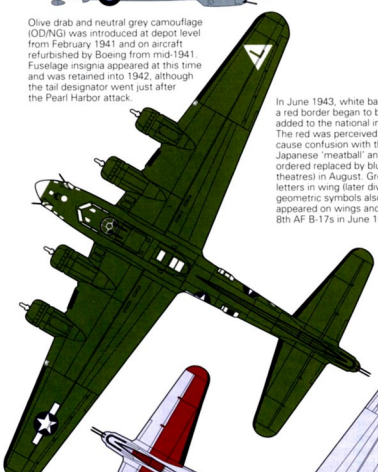
When camouflage was introduced in 1941, the insignia was deleted from the upper port and lower starboard wings. This change resulted from studies that showed gunners would visually aim for the centre point between a pair of markings.

Overall OD top surfaces were found on B-17s in all theatres. A permissible alternative for arid climates was sand over grey, but, while this was applied to B-24s and B-25s, it was never seen on the B-17.

NMF early B-17s such as this B-17C based at Wright Field had no fuselage national insignia, although it was worn on both upper wings.



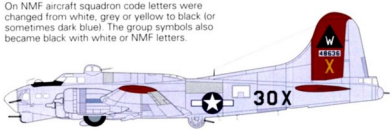
Olive drab and neutral grey camouflage (OD/NG) was introduced at depot level from February 1941 and on aircraft refurbished by Boeing from mid-1941. Fuselage insignia appeared at this time and was retained into 1942, although the tail designator went just after the Pearl Harbor attack.



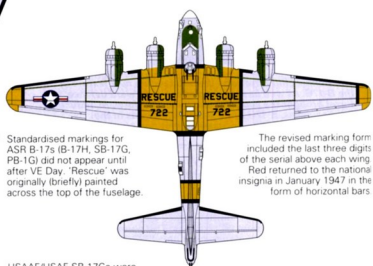
In June 1943, white bars with a red border began to be added to the national insignia. The red was perceived to cause confusion with the Japanese 'meatball' and was ordered replaced by blue (in all theatres) in August. Group ID letters in wing (later division) geometric symbols also first appeared on wings and fins of 8th AF B-17s in June 1943.

Many of the first B-17s to be seen in Europe had field-applied medium green blotching over the basic scheme. This broke up the aircraft's outline when seen from above.

On NMF aircraft squadron code letters were changed from white, grey or yellow to black (or sometimes dark blue). The group symbols also became black with white or NMF letters.



The markings on a late war England-based B-17 revealed a great deal about the aircraft and its place within the structure of the 8th AF. This B-17G is aircraft 'X' (the radio callsign) of the 601st BS (code letters '3O'), 398th BG ('W' on fin), 1st CBW (red tail surfaces and wingtips), and 1st Air Division (triangle base for group letter).

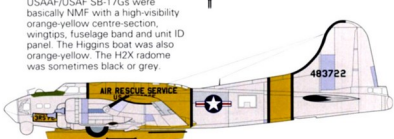


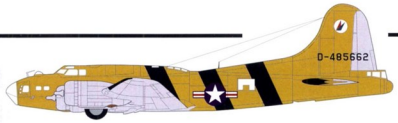
Standardised markings for ASR B-17s (B-17H, SB-17G, PB-1G) did not appear until after VE Day. 'Rescue' was originally (briefly) painted across the top of the fuselage.

The revised marking form included the last three digits of the serial above each wing. Red returned to the national insignia in January 1947 in the form of horizontal bars.

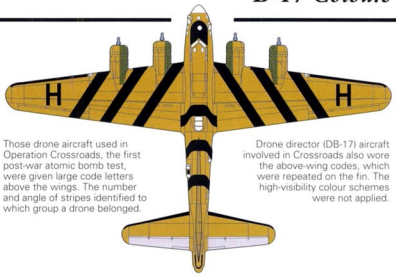
Camouflage began to disappear from B-17s in the 8th AF in February 1944. Olive drab anti-glare panels were added to the inboard faces of the cowls and ahead of the windscreen, a feature not seen on pre-war NMF Fortresses. The fuselage insignia was offset due to the staggered waist windows on B-17Gs. Coloured wing tips and fixed tail surfaces (red) were first applied to 1st CBW B-17s in July 1944; other coloured markings spread to the rest of the 1st AD soon afterwards and to the 3rd AD (yellow tail surfaces) in the winter months of 1944-45.

USAAF/USAF SB-17Gs were basically NMF with a high-visibility orange-yellow centre-section, wingtips, fuselage band and unit ID panel. The Higgins boat was also orange-yellow. The H2X radome was sometimes black or grey.





TB- and QB-17 drone aircraft wore many variations on a basic scheme of Dayglo orange or insignia yellow with black stripes. On some aircraft the underside of the wing was also coloured. Rudders and elevators were usually left in silver dope finish.



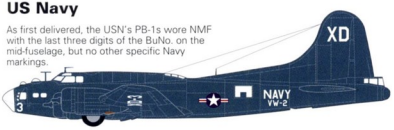
Those drone aircraft used in Operation Crossroads, the first post-war atomic bomb test, were given large code letters above the wings. The number and angle of stripes identified to which group a drone belonged.

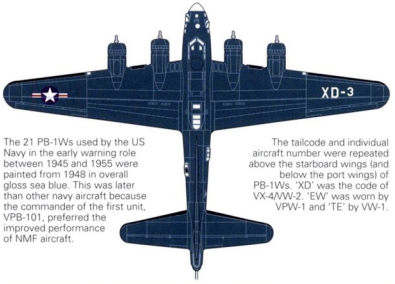
Drone director (DB-17) aircraft involved in Crossroads also wore the above-wing codes, which were repeated on the fin. The high-visibility colour schemes were not applied.

CB- and VB-17s in post-war service often wore the insignia of the parent command on the fin, or the stars and stripes as seen here. Some VB-17s had a black-edged white upper fuselage.

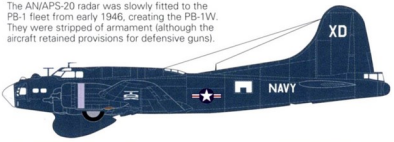
US Navy

As first delivered, the USN's PB-1s wore NMF with the last three digits of the BuNo. on the mid-fuselage, but no other specific Navy markings.





The AN/APS-20 radar was slowly fitted to the PB-1 fleet from early 1946, creating the PB-1W. They were stripped of armament (although the aircraft retained provisions for defensive guns).

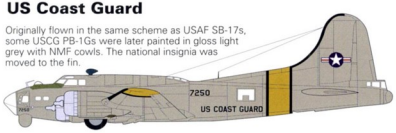


The 21 PB-1Ws used by the US Navy in the early warning role between 1945 and 1955 were painted from 1948 in overall gloss sea blue. This was later than other navy aircraft because the commander of the first unit, VPB-101, preferred the improved performance of NMF aircraft.

The tailcode and individual aircraft number were repeated above the starboard wings (and below the port wings) of PB-1Ws. 'XD' was the code of VX-4/VW-2. 'EW' was worn by VPW-1 and 'TE' by VW-1.

US Coast Guard

Originally flown in the same scheme as USAF SB-17s, some USCG PB-1Gs were later painted in gloss light grey with NMF cowls. The national insignia was moved to the fin.

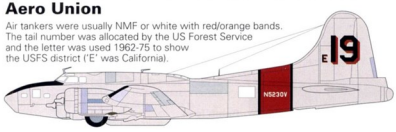


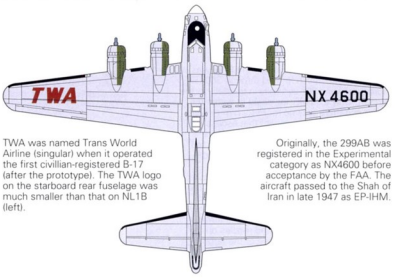
Central Intelligence Agency

The CIA RB-17G operating in Southeast Asia in the 1950s was gloss black with a red 'serial number' on the fin. '531' and '639' were noted.

Aero Union

Air tankers were usually NMF or white with red/orange bands. The tail number was allocated by the US Forest Service and the letter was used 1962-75 to show the USFS district ('E' was California).





TWA was named Trans World Airline (singular) when it operated the first civilian-registered B-17 (after the prototype). The TWA logo on the starboard rear fuselage was much smaller than that on NL1B (left).

Originally, the 299AB was registered in the Experimental category as NX4600 before acceptance by the FAA. The aircraft passed to the Shah of Iran in late 1947 as EP-IHM.

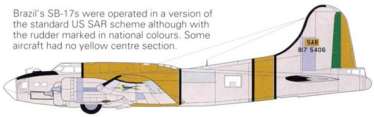
Trans World Airlines

The sole Boeing 299AB Executive was operated by TWA on route survey in 1946-47 with the Limited category registration NL1B.

Foreign operators

Brazil

Brazil's SB-17s were operated in a version of the standard US SAR scheme although with the rudder marked in national colours. Some aircraft had no yellow centre section.



Denmark

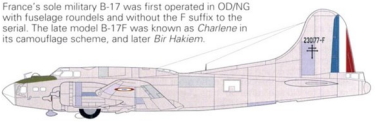
The single RDAF B-17 *Store Bjørn* was formerly OY-DFA and retained the NMF scheme it wore when interned in Sweden as *Shoo Shoo Baby* of the 91st BG.

Dominican Republic

The Dominican Republic's B-17Gs were serialled 2301 and 2302. Earlier they wore the serials 106 and either 107 or 206. They were basically NMF, although at least one was OD/NG at one time.

France

France's sole military B-17 was first operated in OD/NG with fuselage roundels and without the F suffix to the serial. The late model B-17F was known as *Charlene* in its camouflage scheme, and later *Bir Hakiem*.



Germany

The various B-17s captured by the Luftwaffe usually kept their OD/NG finishes, but also had oversized German markings and radio codes. Some KG 200 aircraft had exotic colour schemes and/or black undersides.

Israel

Two of Israel's three B-17s (1602, 1603) were delivered in standard Heyl Ha'Avir four-colour camouflage; the other (1601) was overall sand colour. Later the B-17s were NMF and then wore a two-colour scheme similar to OD/NG.

Japan

The Japanese-captured B-17s were stripped of all USAAF markings but retained their original basic colour schemes. B-17D 40-3095 and the two B-17Es were given white fuselage bands.

Portugal

Portuguese SB-17s, like their Brazilian counterparts, adapted the US standard SAR scheme. National insignia was carried in all six positions. Some aircraft had the upper fuselage area painted white.

Sweden

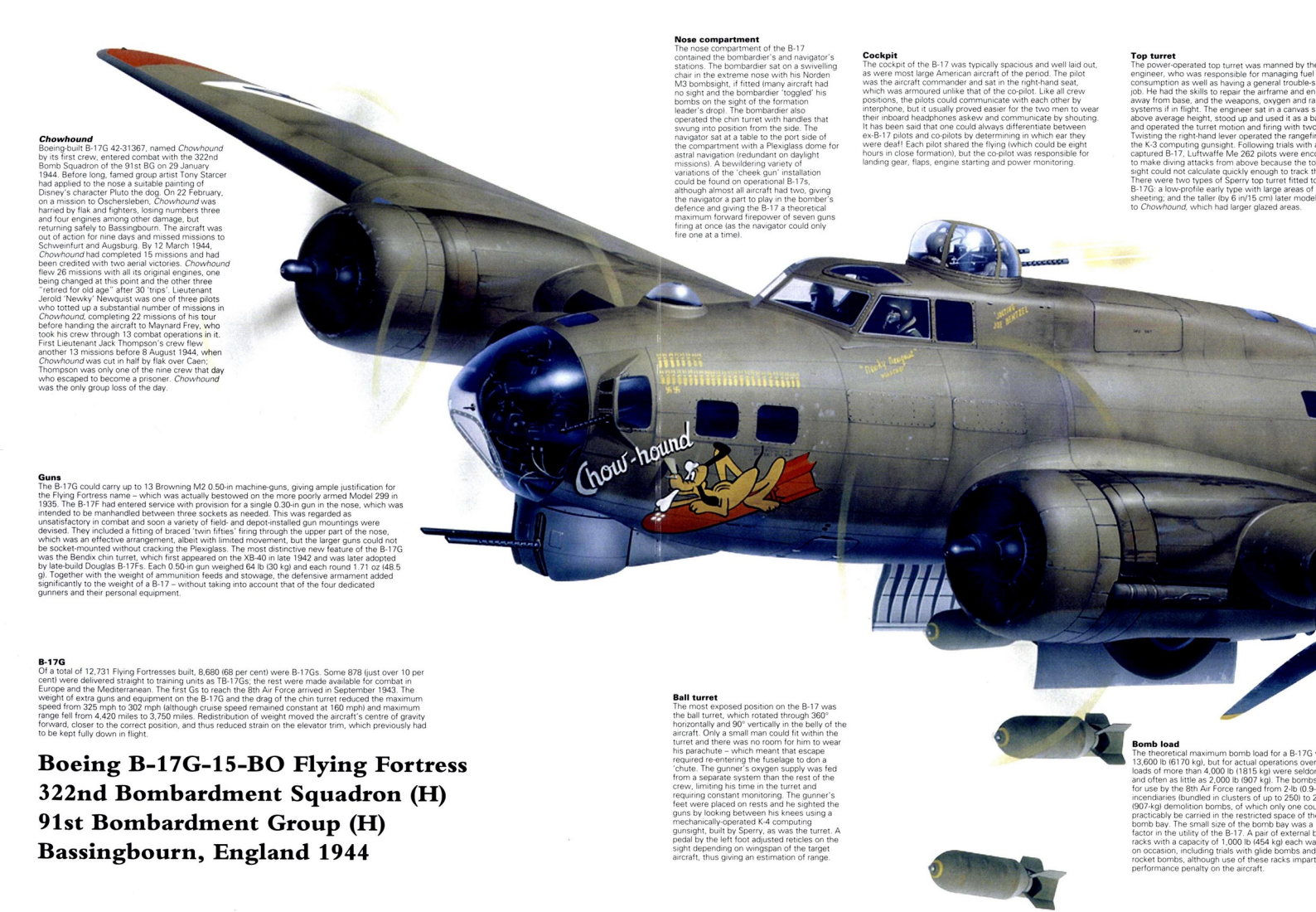
From 1944, AB Aerotransport operated nine of the many B-17s to land in Sweden during the war as airliners. SE-BAK *Jim* was originally B-17F 42-30661 of the 388th BG and retained the basic USAAF camouflage.

SE-BAO was a B-17G-40-BO which was interned in April 1944 and given the name *Ted* in Swedish service. When the war ended, the camouflage was stripped off the aircraft and they operated in the simple scheme seen here.

United Kingdom

The Fortress Mk Is of No. 90 Sqn were delivered in temporary OD/NG camouflage, but received the standard RAF day bomber scheme in service. This was soon altered for the high-altitude role by painting the undersides, lower fuselage and fin azure blue.

Coastal Command B-17s of all versions were painted in the standard maritime pattern of extra dark sea grey over white. Over this was applied a pattern of dark green or dark slate grey. Only a few squadrons carried full codes, others just a single letter as seen on this No. 220 Sqn Fortress Mk II. The code letter was sometimes placed forward of the roundel.



Chowhound

Boeing-built B-17G 42-31367, named *Chowhound* by its first crew, entered combat with the 322nd Bomb Squadron of the 91st BG on 29 January 1944. Before long, famed group artist Tony Starcer had applied to the nose a suitable painting of Disney's character Pluto the dog. On 22 February, on a mission to Oschersleben, *Chowhound* was harried by flak and fighters, losing numbers three and four engines among other damage, but returning safely to Bassingbourn. The aircraft was out of action for nine days and missed missions to Schweinfurt and Augsburg. By 12 March 1944, *Chowhound* had completed 15 missions and had been credited with two aerial victories. *Chowhound* flew 26 missions with all its original engines, one being changed at this point and the other three "retired for old age" after 30 'trips'. Lieutenant Jerold 'Newky' Newquist was one of three pilots who totted up a substantial number of missions in *Chowhound*, completing 22 missions of his tour before handing the aircraft to Maynard Frey, who took his crew through 13 combat operations in it. First Lieutenant Jack Thompson's crew flew another 13 missions before 8 August 1944, when *Chowhound* was cut in half by flak over Caen; Thompson was only one of the nine crew that day who escaped to become a prisoner. *Chowhound* was the only group loss of the day.

Guns

The B-17G could carry up to 13 Browning M2 0.50-in machine-guns, giving ample justification for the Flying Fortress name – which was actually bestowed on the more poorly armed Model 299 in 1935. The B-17F had entered service with provision for a single 0.30-in gun in the nose, which was intended to be manhandled between three sockets as needed. This was regarded as unsatisfactory in combat and soon a variety of field- and depot-installed gun mountings were devised. They included a fitting of braced 'twin fifties' firing through the upper part of the nose, which was an effective arrangement, albeit with limited movement, but the larger guns could not be socket-mounted without cracking the Plexiglass. The most distinctive new feature of the B-17G was the Bendix chin turret, which first appeared on the XB-40 in late 1942 and was later adopted by late-build Douglas B-17Fs. Each 0.50-in gun weighed 64 lb (30 kg) and each round 1.71 oz (48.5 g). Together with the weight of ammunition feeds and stowage, the defensive armament added significantly to the weight of a B-17 – without taking into account that of the four dedicated gunners and their personal equipment.

B-17G

Of a total of 12,731 Flying Fortresses built, 8,680 (68 per cent) were B-17Gs. Some 878 (just over 10 per cent) were delivered straight to training units as TB-17Gs; the rest were made available for combat in Europe and the Mediterranean. The first Gs to reach the 8th Air Force arrived in September 1943. The weight of extra guns and equipment on the B-17G and the drag of the chin turret reduced the maximum speed from 325 mph to 302 mph (although cruise speed remained constant at 160 mph) and maximum range fell from 4,420 miles to 3,750 miles. Redistribution of weight moved the aircraft's centre of gravity forward, closer to the correct position, and thus reduced strain on the elevator trim, which previously had to be kept fully down in flight.

Boeing B-17G-15-BO Flying Fortress
322nd Bombardment Squadron (H)
91st Bombardment Group (H)
Bassingbourn, England 1944

Nose compartment

The nose compartment of the B-17 contained the bombardier's and navigator's stations. The bombardier sat on a swivelling chair in the extreme nose with his Norden M3 bombsight, if fitted (many aircraft had no sight and the bombardier 'toggled' his bombs on the sight of the formation leader's drop). The bombardier also operated the chin turret with handles that swung into position from the side. The navigator sat at a table to the port side of the compartment with a Plexiglass dome for astral navigation (redundant on daylight missions). A bewildering variety of variations of the 'cheek gun' installation could be found on operational B-17s, although almost all aircraft had two, giving the navigator a part to play in the bomber's defence and giving the B-17 a theoretical maximum forward firepower of seven guns firing at once (as the navigator could only fire one at a time).

Cockpit

The cockpit of the B-17 was typically spacious and well laid out, as were most large American aircraft of the period. The pilot was the aircraft commander and sat in the right-hand seat, which was armoured unlike that of the co-pilot. Like all crew positions, the pilots could communicate with each other by interphone, but it usually proved easier for the two men to wear their inboard headphones askew and communicate by shouting. It has been said that one could always differentiate between ex-B-17 pilots and co-pilots by determining in which ear they were deaf! Each pilot shared the flying (which could be eight hours in close formation), but the co-pilot was responsible for landing gear, flaps, engine starting and power monitoring.

Top turret

The power-operated top turret was manned by the engineer, who was responsible for managing fuel consumption as well as having a general trouble-s job. He had the skills to repair the airframe and en away from base, and the weapons, oxygen and ra systems if in flight. The engineer sat in a canvas s above average height, stood up and used it as a bu and operated the turret motion and firing with two Twisting the right-hand lever operated the rangefi the K-3 computing gunsight. Following trials with a captured B-17, Luftwaffe Me 262 pilots were enco to make diving attacks from above because the to sight could not calculate quickly enough to track t There were two types of Sperry top turret fitted to B-17G: a low-profile early type with large areas of sheeting; and the taller (by 6 in/15 cm) later model to *Chowhound*, which had larger glazed areas.

Ball turret

The most exposed position on the B-17 was the ball turret, which rotated through 360° horizontally and 90° vertically in the belly of the aircraft. Only a small man could fit within the turret and there was no room for him to wear his parachute – which meant that escape required re-entering the fuselage to don a 'chute. The gunner's oxygen supply was fed from a separate system than the rest of the crew, limiting his time in the turret and requiring constant monitoring. The gunner's feet were placed on rests and he sighted the guns by looking between his knees using a mechanically-operated K-4 computing gunsight, built by Sperry, as was the turret. A pedal by the left foot adjusted reticles on the sight depending on wingspan of the target aircraft, thus giving an estimation of range.

Bomb load

The theoretical maximum bomb load for a B-17G 13,600 lb (6170 kg), but for actual operations over loads of more than 4,000 lb (1815 kg) were seldom and often as little as 2,000 lb (907 kg). The bombs for use by the 8th Air Force ranged from 2-lb (0.9- incendiaries (bundled in clusters of up to 250) to 2 (907-kg) demolition bombs, of which only one cou practicably be carried in the restricted space of th bomb bay. The small size of the bomb bay was a factor in the utility of the B-17. A pair of external racks with a capacity of 1,000 lb (454 kg) each wa on occasion, including trials with glide bombs and rocket bombs, although use of these racks impart performance penalty on the aircraft.

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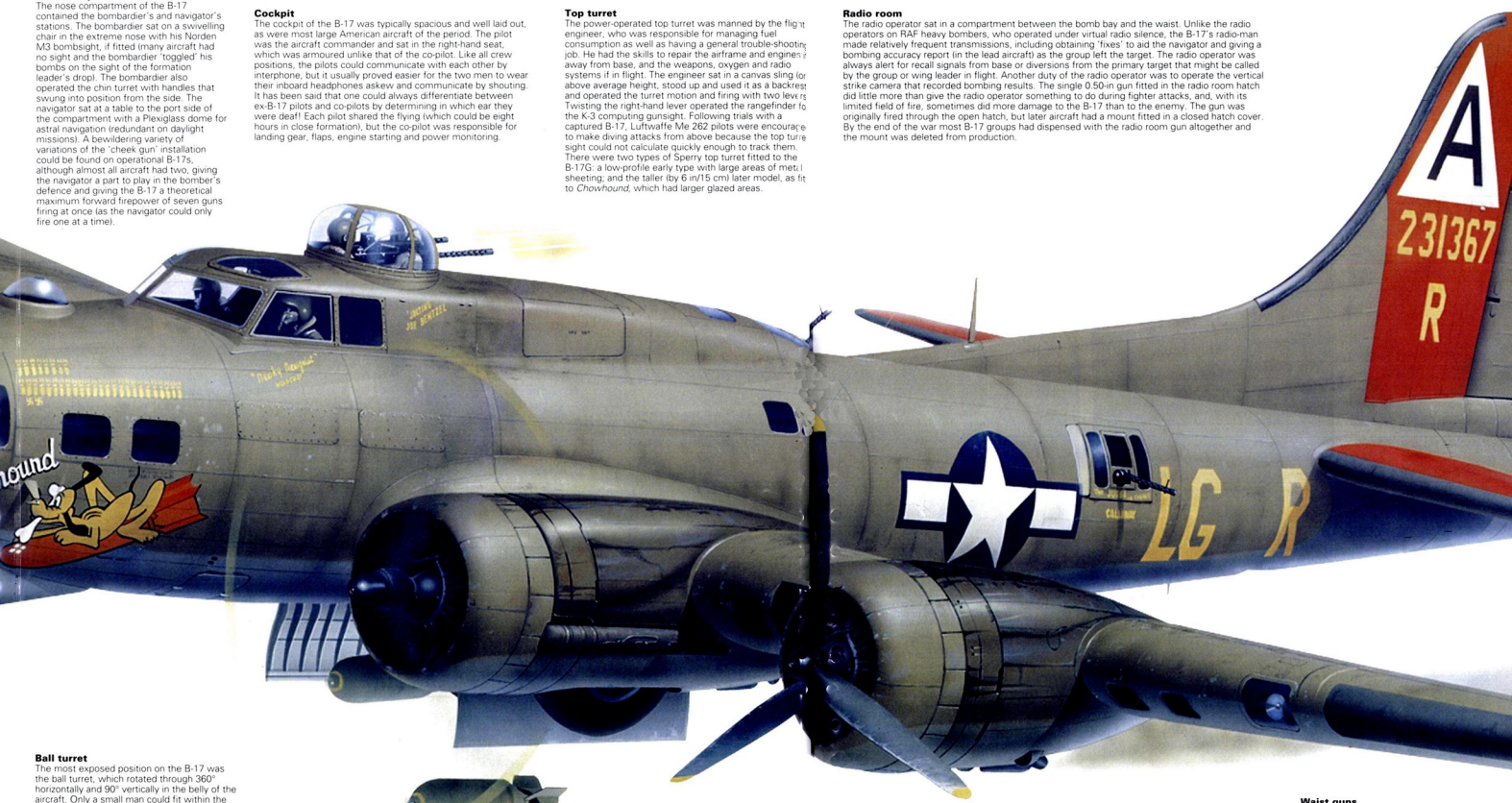
Radio room
The radio operator sat in a compartment between the bomb bay and the waist. Unlike the radio operators on RAF heavy bombers, who operated under virtual radio silence, the B-17's radio-man made relatively frequent transmissions, including obtaining 'fixes' to aid the navigator and giving a bombing accuracy report (in the lead aircraft) as the group left the target. The radio operator was always alert for recall signals from base or diversions from the primary target that might be called by the group or wing leader in flight. Another duty of the radio operator was to operate the vertical strike camera that recorded bombing results. The single 0.50-in gun fitted in the radio room hatch did little more than give the radio operator something to do during fighter attacks, and, with its limited field of fire, sometimes did more damage to the B-17 than to the enemy. The gun was originally fired through the open hatch, but later aircraft had a mount fitted in a closed hatch cover. By the end of the war most B-17 groups had dispensed with the radio room gun altogether and the mount was deleted from production.



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Engines
The B-17G was powered by four nine-cylinder Wright R-1820-98 Cyclone engines, each producing 1,380 hp (1030 kW). From October 1943, B-17Gs were produced with new Honeywell electric turbo-supercharger regulators. They allowed for simultaneous control of engine boost without the problems associated with operation of hydraulic controls at altitude. The result of this was to reduce the proportion of aborted missions and to relieve pilot fatigue brought about by the constant need to monitor the hydraulics of each supercharger. Although a reliable powerplant, the Cyclone ran less smoothly than the R-1830 of the B-24, and many crews wondered why the Pratt & Whitney engine was never fitted to the B-17.

Waist guns
The waist guns on the earliest B-17Gs were fired
open windows as on the B-17F. In order to reduc
discomfort felt by the gunners, closed Plexiglass
Initially, this was a framed three-piece unit as see
improved single-piece clear vision item was introd
mounted on the lower sill rather than on a swivel
Boeing and Vega -50 and Douglas -25 aircraft that
gunners obstructing each other in combat was so
staggered waist gun positions. Due to the infrequ
in actual combat and the limited field of fire of the
position was one of the least effective defensive
statistically one of the most dangerous due to its
Towards the end of the war, many 8th Air Force B
gunner, and the 91st BG flew without either gun
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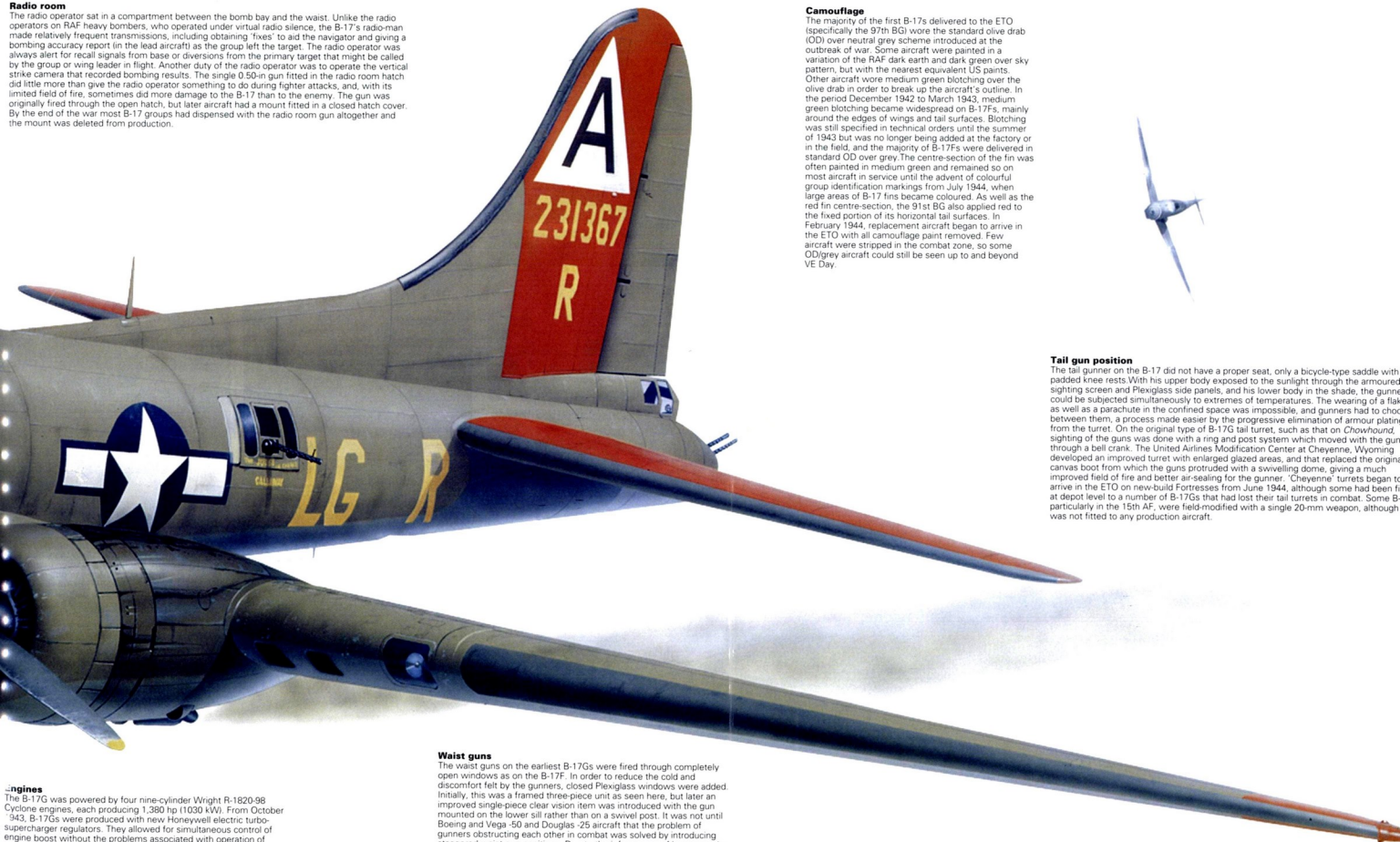
Camouflage
The majority of the first B-17s delivered to the ETO (specifically the 97th BG) wore the standard olive drab (OD) over neutral grey scheme introduced at the outbreak of war. Some aircraft were painted in a variation of the RAF dark earth and dark green over sky pattern, but with the nearest equivalent US paints. Other aircraft wore medium green blotching over the olive drab in order to break up the aircraft's outline. In the period December 1942 to March 1943, medium green blotching became widespread on B-17Fs, mainly around the edges of wings and tail surfaces. Blotching was still specified in technical orders until the summer of 1943 but was no longer being added at the factory or in the field, and the majority of B-17Fs were delivered in standard OD over grey. The centre-section of the fin was often painted in medium green and remained so on most aircraft in service until the advent of colourful group identification markings from July 1944, when large areas of B-17 fins became coloured. As well as the red fin centre-section, the 91st BG also applied red to the fixed portion of its horizontal tail surfaces. In February 1944, replacement aircraft began to arrive in the ETO with all camouflage paint removed. Few aircraft were stripped in the combat zone, so some OD/grey aircraft could still be seen up to and beyond VE Day.

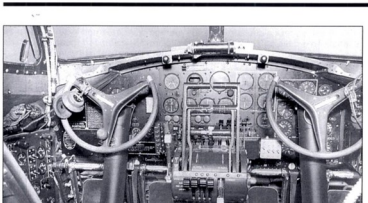
Tail gun position
The tail gunner on the B-17 did not have a proper seat, only a bicycle-type saddle with padded knee rests. With his upper body exposed to the sunlight through the armoured sighting screen and Plexiglass side panels, and his lower body in the shade, the gunne could be subjected simultaneously to extremes of temperatures. The wearing of a flak as well as a parachute in the confined space was impossible, and gunners had to choo between them, a process made easier by the progressive elimination of armour platin from the turret. On the original type of B-17G tail turret, such as that on *Chowhound*, sighting of the guns was done with a ring and post system which moved with the gun through a bell crank. The United Airlines Modification Center at Cheyenne, Wyoming developed an improved turret with enlarged glazed areas, and that replaced the origina canvas boot from which the guns protruded with a swivelling dome, giving a much improved field of fire and better air-sealing for the gunner. 'Cheyenne' turrets began to arrive in the ETO on new-build Fortresses from June 1944, although some had been fi at depot level to a number of B-17Gs that had lost their tail turrets in combat. Some B particularly in the 15th AF, were field-modified with a single 20-mm weapon, although was not fitted to any production aircraft.



Engines
The B-17G was powered by four nine-cylinder Wright R-1820-98 Cyclone engines, each producing 1,380 hp (1030 kW). From October 1943, B-17Gs were produced with new Honeywell electric turbo-supercharger regulators. They allowed for simultaneous control of engine boost without the problems associated with operation of hydraulic controls at altitude. The result of this was to reduce the proportion of aborted missions and to relieve pilot fatigue brought about by the constant need to monitor the hydraulics of each supercharger. Although a reliable powerplant, the Cyclone ran less smoothly than the R-1830 of the B-24, and many crews wondered why the Pratt & Whitney engine was never fitted to the B-17.

Waist guns
The waist guns on the earliest B-17Gs were fired through completely open windows as on the B-17F. In order to reduce the cold and discomfort felt by the gunners, closed Plexiglass windows were added. Initially, this was a framed three-piece unit as seen here, but later an improved single-piece clear vision item was introduced with the gun mounted on the lower sill rather than on a swivel post. It was not until Boeing and Vega -50 and Douglas -25 aircraft that the problem of gunners obstructing each other in combat was solved by introducing staggered waist gun positions. Due to the infrequency of beam attacks in actual combat and the limited field of fire of the guns, the waist position was one of the least effective defensive stations, and also statistically one of the most dangerous due to its exposed nature. Towards the end of the war, many 8th Air Force B-17s carried only one gunner, and the 91st BG flew without either gun in March 1945 as part of a 1st AD experiment.

Inside the B-17



Cockpits of the B-17 series varied little between the 'big tail' models although differences between the B-17E (left) and B-17G (above) can be seen. The control wheels – with wooden yokes on the E – and the absence of the radio compass (localiser) from the centre left of the G panel are two of the more obvious changes.

Boeing B-17F cutaway

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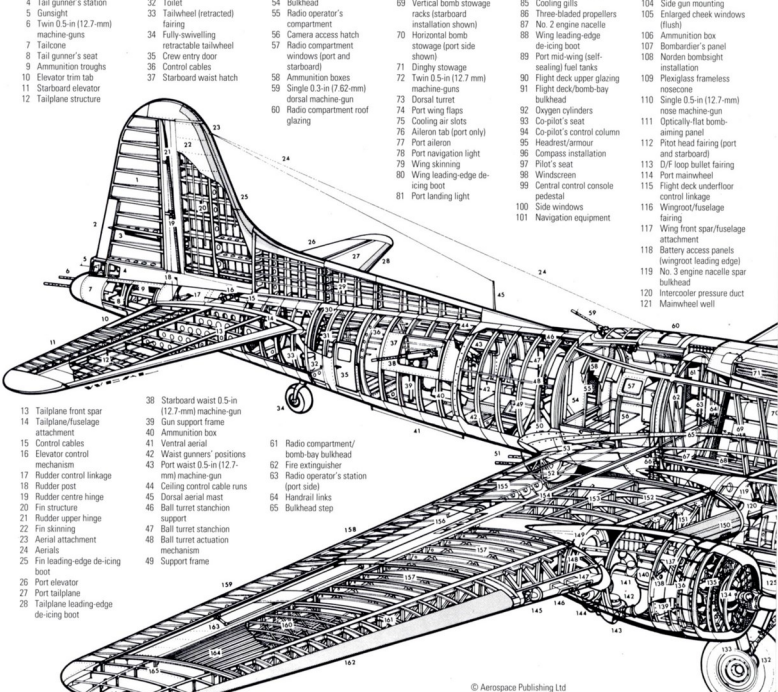
120 Intercooler pressure duct
121 Mainwheel well



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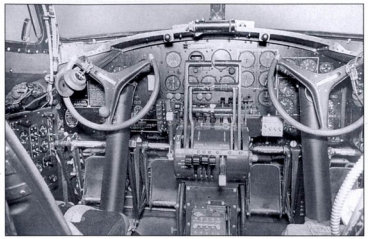
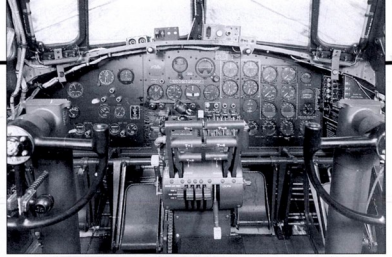
Inside the B-17





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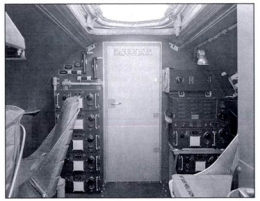

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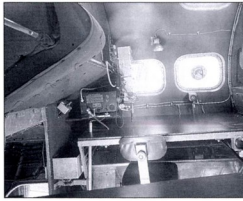

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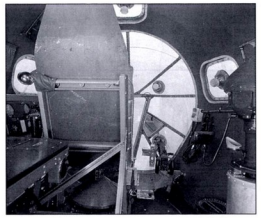

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144 Supercharger waste-gate
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148 Ducting
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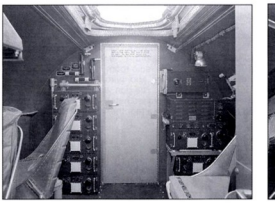

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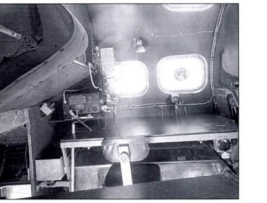

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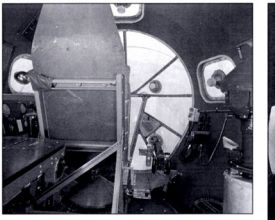

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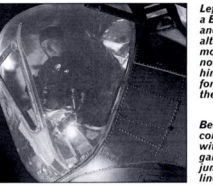

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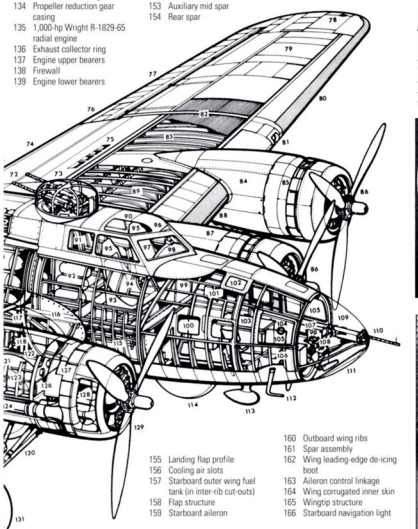

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B-17 armament

Guns

Left: The nose of a B-17G. The chin turret differed only on the B-40s but the cheek gun positions varied greatly. This is the final layout with the starboard gun in the centre window.

Above and below: The top turret changed during B-17F production from the heavily-framed model with restricted view as seen above to a higher-profile model with domed top, below. There was also an interim version with larger clear areas.

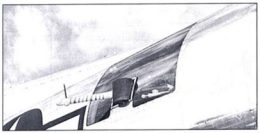
Above: The twin power-boosted waist guns on the XB/YB-40. Each position carried 600 rounds.

Above: The ball turret position was usually occupied by the smallest member of the crew, and then without his parachute. The escape hatch is open here, but the normal entry and egress method was from inside the fuselage.

Above and below: Combat effectiveness of the waist gunners was improved by enclosing and staggering their positions on later B-17Gs.

Left: The original B-17 tail turret had restricted head room and visibility. Sighting was through a ring-and-bead system linked to the guns. Note the signal lamp.

Right: The so-called Cheyenne tail turret offered better visibility, sighting and traverse than the earlier model. It was also longer and protruded from beneath the rudder, necessitating a clear top panel. The guns here have flash suppressors.

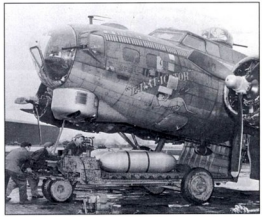


Bombs

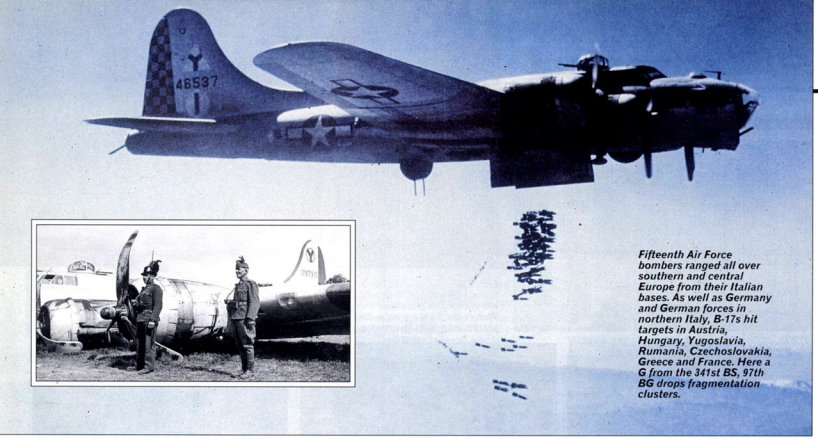
Above: Standard weapons for the B-17 were the M43 500-lb (227-kg) and M44 1,000-lb (454-kg) GP bombs with box fins. The largest bombs of this type carried by B-17s were 2,000 lb (908 kg).

Right: One of the many types of bomb dropped in clusters was the M-17 incendiary cluster. Each of the M-17s in these further clusters of four contained 110 4-lb (1.8-kg) incendiaries.

Above: External bomb racks were fitted from the B-17F-30-BO and B-17F-70-VE and -DLs, although they were used relatively infrequently.



Above: Napalm was occasionally used in the ETO from mid-1944, usually in 108-US gal (409-litre) compressed-paper fighter-type drop tanks. A B-17 usually carried four of these 'fire bombs'.



Fifteenth Air Force bombers ranged all over southern and central Europe from their Italian bases. As well as Germany and German forces in northern Italy, B-17s hit targets in Austria, Hungary, Yugoslavia, Rumania, Czechoslovakia, Greece and France. Here a G from the 341st BS, 97th BG drops fragmentation clusters.

Inset: A downed B-17G of the 15th AF's 2nd BG is guarded by local militiamen, probably in Hungary, 1944.

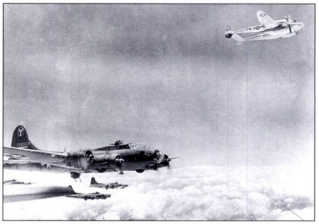
Far right: B-17Fs of the 96th BS, 2nd BG are passed by their P-38 escort. P-38s served longer in the 15th AF than in the 8th. The three groups so equipped retained Lightnings throughout their existence.

27 January 1943 marked the first mission of the Eight Air Force heavy bombers into Germany. The naval base at Wilhelmshaven was bombed and, although a large number of fighters rose to protest, only one B-17 failed to return. The Battle of Germany had begun.

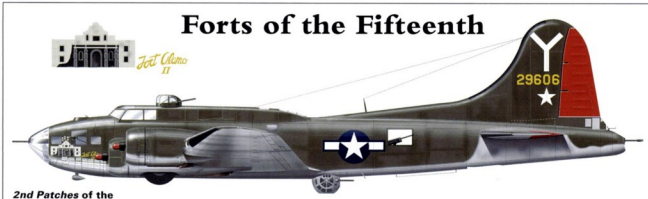
By spring 1943 the operational groups of B-17s in the 8th Air Force were capable of launching up to 100 bombers. Enemy fighter attacks got more vicious when the Luftwaffe found the weak point on the Fortress. They came in from 12 o'clock, where the armament of the B-17 was the lightest. This tactic prompted many field modifications of new gun installations in the nose of the aircraft.

Schweinfurt and Regensburg

Sixteen B-17 groups were available when the 8th Air Force launched its Schweinfurt-Regensburg mission on 17 August 1943. The 1st Bomb Wing (as it was then called) dispatched 230 B-17s to hit the ball bearing factory at Schweinfurt, while the 4th Bomb Wing sent 146 B-17s against aircraft factories at Regensburg. The Regensburg force took off first and had to fight its way to the target,



Forts of the Fifteenth



131 mission marks on the nose of *Fort Alamo II* of the 840th BS, 483rd BG testify to the long, hard-fought but largely unheralded war of the 15th AF in Italy. In spring 1944, the geometric tail symbols became backgrounds for the 5th Wing's 'Y', except by the new 483rd BG who adopted this star marking and a red rudder.

***2nd Patches* of the 346th BS, 99th BG took part in Operation Frantic, the first shuttle mission to the USSR on 2 June 1944, landing in the Ukraine. This B-17 gained its name from the amount of battle damage it suffered and the extensive new metalwork applied, including a new fin and rudder and rear crew entry door donated by a cannibalised natural metal aircraft and never recamouflaged.**

The basic B-17E airframe as completed by Boeing cost between $190,147 and $195,577 according to batch, with the final cost (including government-furnished equipment and engines, etc.) ranging from $298,065 to $302,772. Difficulties with materials and labour delayed the start of B-17E production by 150 days. By the time the 512th and last was delivered, deliveries were 49 days ahead. This is not the Boeing B-17E line at Seattle as it may have appeared, but B-17E fuselages at Vega's Burbank plant used for the production of jigs in the lead-up to full operation of the Boeing-Vega-Douglas pool.

from where it continued to North Africa, losing 24 aircraft en route. The Schweinfurt force with its 230 B-17s was not airborne until the afternoon. It, too, felt the full brunt of the Luftwaffe, and 36 of its Fortresses did not return from the mission.

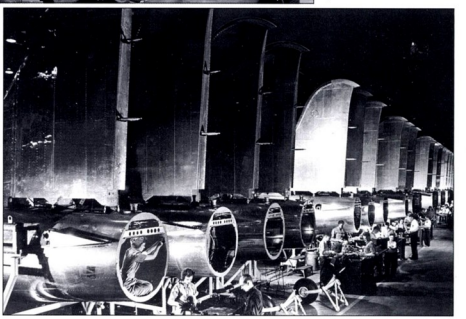
The Fortresses continued to take heavy losses on their unescorted missions deep into Germany and the future of daylight bombing looked uncertain. Odds rose against crew members surviving their tour of 25 combat missions, and morale was low. The B-17 was not unsuited to its job, for it was absorbing unbelievable damage and still somehow returning to base; it was just that the numbers of the fighters and their dogged determination was overpowering. Sixty more Fortresses were lost on another mission to Schweinfurt on 14 October 1943.

Long-range fighter escort

In December 1943 the long-range P-51 Mustang and P-38 Lightning fighters began to assume the long-range escort duties. From then, Fortress losses began to drop, quite drastically as time went on and the escort became stronger.

One of the highlight mission for the Fortresses took place on 6 March 1944, when they journeyed to Berlin for the first time. Of course, the Luftwaffe was up in full force and the escort came along, but 474 B-17s dropped their bombs on the capital of the Third Reich. Fifty-three B-17s did not make it home, but the aircraft had proved that it could take all that the Luftwaffe and the flak could offer and still accomplish its mission.

By D-Day, the Allies had gained complete air superiority. As the bomber force of the 8th Air Force grew, B-17s attacked all of Germany in great numbers. They also flew numerous tactical raids in France to support the invasion. The summer of 1944 saw the B-17s concentrate their efforts against oil, transportation and military vehicle production throughout the Third Reich. On 24 December



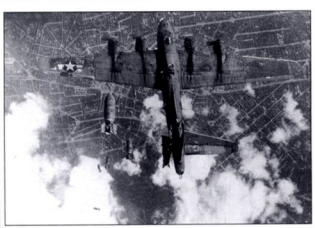
Above: A seemingly endless line of B-17 tails marches along one of the B-V-D partners' assembly lines. As with all US wartime aircraft, a substantial amount of the work was done by women, known collectively and affectionately as 'Rosie the Rivetter'.

Left and above left: At the peak of B-17 production in March 1944, just under 19 aircraft per day were rolling from plants in Seattle (Boeing), Burbank (Vega) and Long Beach (Douglas) for a grand total of 12,726. Over one-third of these (4,750) were to be lost in combat.

Hazards of combat

Above: Flak – no amount of extra machine-guns could defend against the batteries of 88-mm guns ranged around every target in Europe. Pilots just had to grit their teeth and press on through – while maintaining a stable bomb run.

Above: Fighters – a 94th BG B-17 lies peppered with cannon holes, June 1944. Many crewmen preferred fighters to flak, as they could at least shoot back.



Above: 'Friendly' bombs – this B-17 of the 94th BG was lost over Berlin to a 500-lb bomb from a sister aircraft. None of the crew escaped.

Above: Take-off and landing crashes – a B-17 of the 379th BG burns furiously in the darkness after crashing on return from Schweinfurt, February 1944.

Collision – many bombers were lost in collisions with others, particularly when forming up over England. The crew of this B-17F were luckier than most when they brought their aircraft home after losing the rudder and most of the fin to the props of another over St Omer.

Above: Ground explosion – the detonation of a bomb being loaded into another aircraft wrecked this B-17F and others, 28 May 1943. The worst such incidents cost over 30 lives.

Enemy bombs – the Luftwaffe had limited success with aerial bombing of bomber formations. This 331st BS, 99th BG aircraft was said to be the victim of an 'enemy' B-17's bombs.

1944, the 8th Air Force sent over 2,000 heavy bombers against targets in Germany, 1,400 of which were B-17s.

B-17 strength in the 8th Air Force peaked in March 1945 with 2,367 examples. Twenty-six operational bombardment groups flew B-17s, including five units that converted from B-24s late in 1944. In the course of its combat operations the Eighth Air Force lost 3,219 B-17s to enemy action. The B-17s in northwest Europe and the Mediterranean theatre of operations dropped 640,136 tons of bombs on enemy personnel and installations.

Twelve B-17 crew members in the Eighth Air Force won Medals of Honor as a result of their actions on combat missions, as follows:

Lieutenant Jack Mathis, a bombardier from the 303rd Bomb Group, died at his bombsight on 18 March 1943. Sergeant Maynard Smith of the 306th Bomb Group fought off enemy fighters and put out the fires in his B-17 on 1 May 1943, making it possible for the aircraft to return to base. Flying Officer John C. Morgan of the 92nd Bomb Group had to fight off the semi-conscious actions of his wounded pilot to keep his B-17s in formation, bomb the target and bring it home on 26 July 1943. Technical Sergeant Forrest Vosler, a radio operator from the 303rd Bomb Group, although badly wounded and nearly blinded, fought off enemy fighters, sent out distress signals and saved one of his crew members after ditching on 20 December

B-17G-55-DL
833rd BS, 486th BG
Sudbury, 1945

Squadron markings
As a further distinction from wing and group markings, each squadron in many groups (including the 486th) wore coloured nose bands and propeller bosses. *Short Arm* had a medium blue nose band but bright green prop bosses which were a hangover from previous assignment to the 835th BS. The other squadron colours were yellow for the 832nd BS and red for the 834th BS. *Short Arm* was in service with the group before the introduction of the new markings, as evidenced by the overpainting of the individual aircraft letter on the rear fuselage by the coloured bands and its replacement further forward.

Wing markings
The yellow tail markings of *Short Arm* denoted an aircraft of the 4th Combat Bomb Wing, which comprised the 94th, 447th, 486th and 487th Bomb Groups. When new markings were suggested by the 3rd Bomb Division at the end of 1944 for the bomb wings under its command, 4th CBW disapproved of the inverted chevron on the tail that was proposed for its aircraft. The wing suggested yellow tail surfaces as its own identification marking and these were adopted after a trial period in February 1945.

Armament
The B-17G was one of the most heavily-armed bombers of the war, fielding up to 13 0.50-in machine-guns. Diminishing fighter opposition in the war's last months allowed for the removal of some guns, (and their ammunition) which in turn allowed for increased fuel and/or equipment. *Short Arm* had no cheek or radio-room guns. B-17 pathfinder aircraft usually replaced the ball turret with a 'Mickey' H2X ground scanner radome .

Group markings
In addition to the group identification letters, the groups of the wing adopted coloured fuselage bands and upper right/lower left wing chevrons in the following combinations: 94th BG, single red band and red chevron; 447th BG, two green bands, blue chevron; 486th BG, three yellow bands, red/blue chevron; and 487th BG, no band, yellow/red chevron.

Tail turret
The 'Cheyenne' tail turret was introduced as a production item on Douglas Block-45, Vega -55 and Boeing -80 aircraft and gave the gunner improved vision, sighting and traverse over the earlier model turret.

Late B-17G
Short Arm represents the definitive standard for a late-production Flying Fortress as delivered to the 8th Air Force around the end of 1944, and as such combined all the refinements incorporated in previous production blocks. The most obvious of these related to armament, but engines, electrical, hydraulic and oxygen systems were subject to constant modification during production. Douglas was the first member of the B-V-D pool to fit cheek guns as standard to B-17Gs. Previous installations had been field modifications with a range of variations.

Waist guns
The arrangement of port gun forward and rear gun further back became adopted as standard. The reverse arrangement was adopted for the waist gun positions, which were enclosed and staggered from B-17G-50-BO, -25-DL and -VE aircraft onwards. The revised waist gun positions prevented 'fanny bumping' by the gunners who had limited space in which to manoeuvre their guns, encumbered as they were by heavy flying clothing, oxygen, intercom and ammunition feeds.

Fancy Forts

Fearless Fosdick *was a popular name, and appeared on a dozen different B-17s.*

Nov Schmoz Ka Pop *must have meant something to the crew of this 94th BG B-17G.*

Tiger Girl *was a rare shark-mouthed B-17 flying with the 560th BS, 388th BG.*

Wicked Witch, *B-17G-50-BO 42-102490 of the 323rd BS, 91st BG, flew more than 70 missions.*

Fifinella *was the name for a female gremlin and B-17G-35-DL 42-107030 of the 91st BG.*

'Jacket art' on the crew of **Pistol Packin' Mama,** *one of many B-17s so named.*

One of the most unusual-looking B-17s was* Little Miss Mischief *of the 91st BG (above left). After nearly being blown in two by flak over Cologne, it was repaired using the rear fuselage from an older, camouflaged B-17. Less well known is this aircraft (above), nominally B-17G-100-BO 42-39064 'G' of the 457th BG, which had the opposite arrangement of spare parts. It is not certain from which end of the bomber the serial originates.

8th Air Force B-17 units

Groups	Period	Main base(s)
91st Bombardment	Nov 1942 to May 1945	Bassingbourn
92nd Bombardment	Sep 1942 to May 1945	Bovingdon/Alconbury/Podington
94th Bombardment	May 1943 to May 1945	Bury St Edmunds
95th Bombardment	May 1943 to May 1945	Horham
96th Bombardment	May 1943 to May 1945	Snetterton Heath
97th Bombardment	Jun 1942 to Sep 1942	Polebrook/Grafton Underwood
100th Bombardment	Jun 1943 to May 1945	Thorpe Abbots
303rd Bombardment	Nov 1942 to May 1945	Molesworth
305th Bombardment	Nov 1942 to May 1945	Chelveston
306th Bombardment	Oct 1942 to May 1945	Thurleigh
351st Bombardment	May 1943 to May 1945	Polebrook
379th Bombardment	May 1943 to May 1945	Kimbolton
381st Bombardment	Jun 1943 to May 1945	Ridgewell
384th Bombardment	Jun 1943 to May 1945	Grafton Underwood
385th Bombardment	Jul 1943 to May 1945	Great Ashfield
388th Bombardment	Jul 1943 to May 1945	Knettishall
390th Bombardment	Aug 1943 to May 1945	Framlingham
398th Bombardment	May 1944 to May 1945	Nuthampstead
401st Bombardment	Nov 1943 to May 1945	Deenethorpe
447th Bombardment	Dec 1943 to May 1945	Rattlesden
452nd Bombardment	Feb 1944 to May 1945	Deopham Green
457th Bombardment	Feb 1944 to May 1945	Glatton
34th Bombardment *	Sep 1944 to May 1945	Mendlesham
486th Bombardment *	Aug 1944 to May 1945	Sudbury
487th Bombardment *	Aug 1944 to May 1945	Lavenham
490th Bombardment *	Aug 1944 to May 1945	Eye
493rd Bombardment *	Sep 1944 to May 1945	Debach

* These units entered combat as B-24 groups and converted to B-17s in the months shown.

Other 8th Air Force B-17 Units

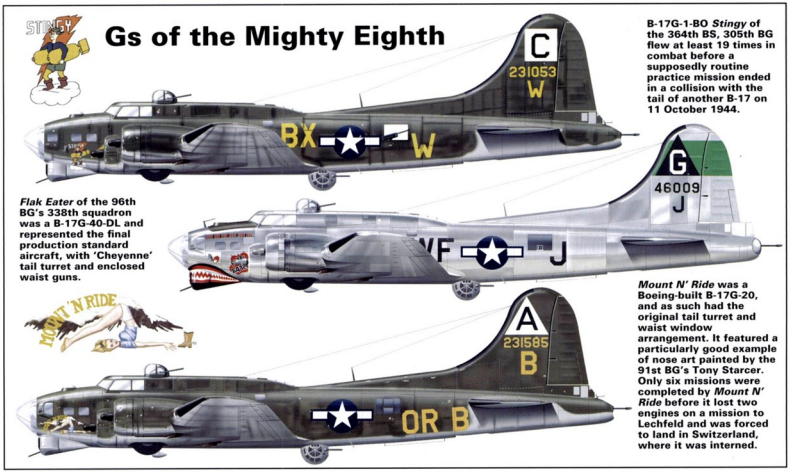
36th Bomb Squadron (radio countermeasures squadron) 1944-45 (Sculthorpe, Oulton, Cheddington, Alconbury)
5th Emergency Rescue Squadron 1945 (Boxted, Halesworth)
1st Air Division Headquarters Flight 1944-45
3rd Air Division Headquarters Flight 1944-45

The first of all the B-17 units to fly combat in the ETO was the 97th BG, whose B-17Es led the first American heavy bomber raid on Europe, 17 August 1942.* Peggy D *flew on that mission but was lost over Lorient on 21 October. The 97th moved to Africa in November 1942 for participation in Operation Torch with the 12th Air Force.

When the P-51 Mustang joined the 8th AF in January 1944, the bombers finally had an escort that could go all the way to Berlin. Passing through this 381st BG formation is a P-51B or C of the 355th FG, summer 1944.

Below: The changeover to 'all-silver' units was a slow one as aircraft retained camouflage until lost or retired. Crews in groups with few natural metal aircraft often feared they would be singled out for extra attention from the Luftwaffe. The first group to fly an all non-camouflaged formation was the 457th BG.

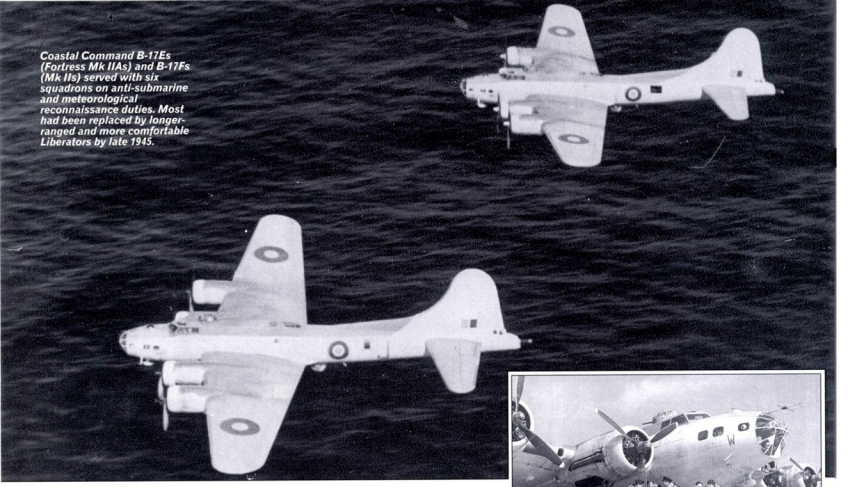
1943. Lieutenant William R. Lawley, pilot from the 305th Bomb Group, although badly wounded, brought his wounded crew back to England on 20 February 1944. Lieutenant Walter Truemper, navigator, and Sergeant Archie Mathies, gunner, from the 351st Bomb Group, were killed on 20 February 1944, when they attempted to make a landing with their wounded pilot aboard. Lieutenant Edward Michael, pilot from the 305th Bomb Group, although badly wounded, discovered that his bombardier's parachute had been burned and managed to bring his aircraft back to England on 11 April 1944. Lieutenant Robert E. Feymoyer, navigator in the 447th Bomb Group, although badly wounded, refused aid until he guided his aircraft home on 2 November 1944; he died shortly after arrival. Lieutenants Donald J. Gott and William E. Metzger, pilot and co-pilot from the 452nd Bomb Group, were killed attempting a landing in friendly territory to save their wounded radio operator on 9 November 1944. Brigadier General Fred Castle of the



B-17G-1-BO *Stingy* of the 364th BS, 305th BG flew at least 19 times in combat before a supposedly routine practice mission ended in a collision with the tail of another B-17 on 11 October 1944.

***Flak Eater* of the 96th BG's 338th squadron was a B-17G-40-DL and represented the final production standard aircraft, with 'Cheyenne' tail turret and enclosed waist guns.**

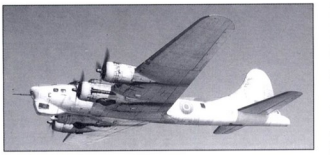
***Mount N' Ride* was a Boeing-built B-17G-20, and as such had the original tail turret and waist window arrangement. It featured a particularly good example of nose art painted by the 91st BG's Tony Starcer. Only six missions were completed by *Mount N' Ride* before it lost two engines on a mission to Lechfeld and was forced to land in Switzerland, where it was interned.**



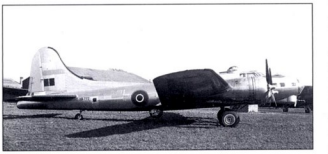
Coastal Command B-17Es (Fortress Mk IIAs) and B-17Fs (Mk IIs) served with six squadrons on anti-submarine and meteorological reconnaissance duties. Most had been replaced by longer-ranged and more comfortable Liberators by late 1945.

Above: This picture of a Fortress Mk II (FL452 of No. 206 Squadron) was one of the first released in the UK to acknowledge the existence of airborne radar (in this case ASV Mk II). The fit included nose and mid-wing Yagi aerials.

Right: FK185 was the only recipient of the 40-mm Vickers 'S' gun, intended as an anti-submarine weapon and tested by the A&AEE in early 1944. The nose glass was replaced by a solid dome, and a new bomb-aimer's station was added underneath.



Below: Of the hundreds of B-17s that fell on German-occupied soil, the Luftwaffe rebuilt seven to fly. Most of these were used to train fighter pilots in defeating the Flying Fortress, but others were used to shadow the 8th AF's B-17 formations, for transport duties and for agent drops over the USSR under the spurious designation 'Do 200'. DL+XC was originally Wulf Hound *of the 303rd BG.*



Above: Although less well known than the Coastal Command B-17s, the bulk of RAF Fortresses (98 out of approximately 170) were B-17Gs. Used mainly in the RCM role, they were delivered in the summer of 1944.

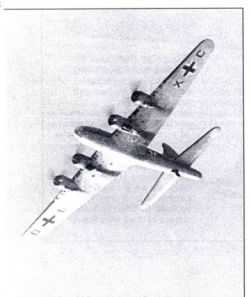
4th Bomb Wing was leading the 8th Air Force on a mission on 24 December 1944 when his aircraft was downed; Castle managed to bail his crew out before it crashed.

B-17s in the Med

In summer 1943 the Fortress units flew many missions against targets in Sicily and were the prime constituents in the surrender of the island of Pantelleria. This marked one of the first times that an enemy bastion had fallen to air power.

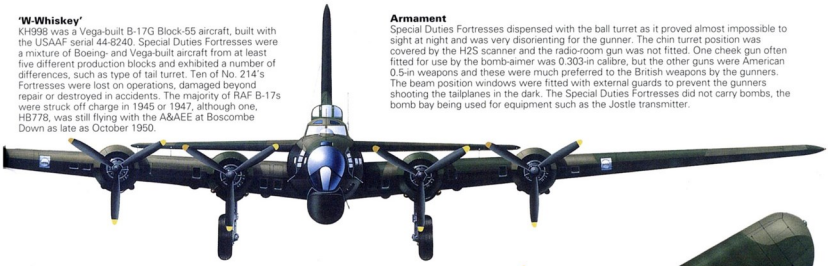
In November 1943 the 15th Air Force was formed to become the strategic air force in the Mediterranean. At that time the targets for the B-17s were prime industrial and petroleum complexes in southern Germany, Austria,

Below: In the build-up to D-Day, thousands of new B-17s arrived in the UK and were stored at air depots until they could be issued to units. When the war was over, similar scenes were repeated as bombers awaited the scrapman.



'W-Whiskey'
KH998 was a Vega-built B-17G Block-55 aircraft, built with the USAAF serial 44-8240. Special Duties Fortresses were a mixture of Boeing- and Vega-built aircraft from at least five different production blocks and exhibited a number of differences, such as type of tail turret. Ten of No. 214's Fortresses were lost on operations, damaged beyond repair or destroyed in accidents. The majority of RAF B-17s were struck off charge in 1945 or 1947, although one, HB778, was still flying with the A&AEE at Boscombe Down as late as October 1950.

Armament
Special Duties Fortresses dispensed with the ball turret as it proved almost impossible to sight at night and was very disorienting for the gunner. The chin turret position was covered by the H2S scanner and the radio-room gun was not fitted. One cheek gun often fitted for use by the bomb-aimer was 0.303-in calibre, but the other guns were American 0.5-in weapons and these were much preferred to the British weapons by the gunners. The beam position windows were fitted with external guards to prevent the gunners shooting the tailplanes in the dark. The Special Duties Fortresses did not carry bombs, the bomb bay being used for equipment such as the Jostle transmitter.



Boeing Fortress Mk III
No. 214 (Special Duties) Sqn
No. 100 (SD) Group
Oulton 1944

Crew
Like most USAAF Fortresses, those of 100 Group carried a crew of 10, but its composition more closely reflected RAF heavy bomber practice. The crew consisted of pilot, flight engineer, bomb-aimer, two navigators, a special operator for the jamming equipment, and four gunners (two waist or 'beam', dorsal turret and tail turret).

No. 100 (Special Duties) Group was formed in November 1943 to co-ordinate radar counter measures (RCM) and other deception efforts within Bomber Command. Prior to this, diversionary and defence suppression efforts had been the responsibility of a variety of units spread across the command and were diverting an increasing number of bombers away from their prime task. The group operated six squadrons of heavy bombers including all the main four-engined types (sometimes mixed within squadrons) as well as 15 primarily equipped with the Mosquito. Other types used by 100 Group included the Beaufighter, Wellington and Defiant.

Aerials and equipment
The Fortresses and other bombers of No. 100 Group were festooned with aerials and domes. Each of these was associated with an item of jamming or listening equipment. The principal aerials on this aircraft and their functions were (from nose to tail): **H2S:** (chin dome) ground mapping navigation radar. **Piperack:** (whip aerials above wings) radar jammer, particularly Air Intercept (AI). **Carpet:** (under mid-fuselage aerial) jammer directed at Würzburg GCI radars. **ABC (Airborne Cigar):** (large upper fuselage aerial) jammer for German radio (R/T) transmissions and homing beacons. A shorter aerial at this point signified a **Jostle** transmitter for jamming R/T across all six bands. **Window:** chute (below waist windows) for radar-deceiving chaff. **Airborne Grocer:** (either side of tail turret) jammer for AI radars. **Monica:** (between tail guns) tail warning radar.

Lifeboat

The development of a specialised B-17 variant for dropping lifeboats to downed airmen (particularly heavy bomber crews) began in 1943, but various delays in obtaining enough suitable aircraft prevented their entering service with the 8th AF until March 1945. Six such B-17H aircraft slated for the ETO went to the Pacific where they provided rescue cover for B-29 raids, a task repeated in the early part of the Korean War. In 1945, 17 lifeboat aircraft were given to the Coast Guard and designated PB-1G. They served until 1958.

Above: An SB-17G of Alaskan Air Command is seen during 1950. Alaskan-based 'Dumbos' were called out on many searches for lost aircraft and people. Presumably the lifeboat could have been dropped over land as a way of getting supplies to survivors.

Right: Air Force and Coast Guard B-17s were fitted with the 27-ft (8.2-m) Higgins A-1 lifeboat with a nominal capacity of 12. Most had an H2X radome under the chin.

Top: Fully-armed SB-17Gs (redesignated in 1948) flew from Iwo Jima in two wars. When the MiG-15 appeared over Korea, they were withdrawn in favour of SB-29s. Here a 3rd ARS aircraft, having dropped its boat, returns to Ie Shima over the heads of indifferent Okinawan labourers, August 1951.

Above: An SB-17 could be found wherever the USAF had a presence in a remote or oceanic area. This aircraft, with an arctic red tail, was based at Keflavik in Iceland. A lesser-known role of the PB-1G was iceberg tracking as part of the Civil Ice Patrol. Two aircraft were assigned to the patrol each spring and were based at Argentia, Newfoundland.

PB-1G Bu No. 77250 served at Coast Guard Air Stations Brooklyn, Elizabeth City and Port Angeles. Unlike most USCG PB-1s, it was painted – in a light grey scheme with natural metal cowlings. In 1958 it was sold on the civil market and met its end when it crashed in Bolivia in 1963 as CP-694.

Greece and the Balkans. The Fifth Wing was reinforced in March 1944 by the arrival of the 463rd Bomb Group, and the sixth and final B-17 unit arrived in April 1944 in the form of the 483rd Bomb Group.

Attacks on the oil industry

The Fifth Wing gained prominence in its campaign against the Ploesti oil complex in Romania, but it also attacked numerous synthetic oil refineries in Czechoslovakia and southern Germany. Aircraft factories in Austria and tactical targets in Italy and Yugoslavia were also bombed on many occasions. The capstone for the 5th Wing came in March 1945 when it flew all the way to Berlin to bomb the Daimler-Benz tank factory. At its peak, the 15th Air Force was equipped with 538 B-17s.

One 15th Air Force B-17 crew member was awarded the Medal of Honor. On 23 June 1944, Lieutenant David R. Kingsley was the bombardier on a Fortress from the 97th Bomb Group that bombed a refinery at Ploesti. The aircraft was badly damaged by flak and then came under attack by fighters. Several men were wounded, including the tail gunner. When the bail out order was given it was discovered that the tail gunner had no parachute. Kingsley gave his to the gunner and perished in the crash of the B-17.

The 8th Air Force B-17 force outnumbered the B-24s by about two to one, while the reverse was true in the 15th Air Force. By and large the crew members of Fortresses were much more pleased with their aircraft than the Liberator crews. The B-24 had slightly more range that the B-17, was a little faster and could carry a heavier bomb load. The B-17 had an altitude advantage and could fly a much tighter formation than the B-24 with its thin Davis wing. Tightness of formation was essential in combat with Luftwaffe fighters. The Liberator was much more susceptible to fire than the B-17 and could certainly not take the wing punishment that the Fortress could and still come home

During the course of World War II, small numbers of B-17s were modified for other duties, and one in particular was modified to become a new model of aircraft. It was B-17E 41-2401, turned over to Lockheed for study. This aircraft had its Wright R-1820 engines replaced with Allison V-1710-89 1,425-hp (1068-kW) liquid-cooled V-type engines. The modified aircraft was designated XB-38. Few other changes were made in the aircraft other

Above: A DB-17 (on the right) flies close as it guides a QB-17 down to a landing somewhere in the Pacific. The tally symbol marks this runway as 8,000 ft (2440 m) long.

than to house the coolant radiators for the liquid-cooled engines in the leading edges of the wings. Top speed of the aircraft was 327 mph (526 km/h) at 25,000 ft (7620 m), and the range was 2,400 miles (3860 km) at 226 mph (364 km/h). Only one aircraft was modified and it first flew on 19 May 1943. It was lost on 16 June 1943, when one of the engines developed a fire and the crew was forced to bail out.

US Navy use

The US Navy took very few models of the Boeing B-17. The largest number were B-17s that had been updated to B-17G standards, and were designated PB-1W. They were used on anti-submarine patrols. The most significant change was the large plastic radome initially installed under the fuselage at the bomb bay location. Most of the radomes were located on top of the fuselage rather than below it, and all post-war USN examples had the radome located in that position.

A number of B-17s that had been stripped of their armament and armour plate became executive transports. One of the best known was a B-17E (41-2593) which became *Bataan*, the personal transport of General Douglas MacArthur in 1943. The aircraft was designated XC-108. Quite a few other B-17s were converted similarly, not only in the Pacific but more prominently in the European theatre of operations.

Another modification of the B-17 was considered 'top

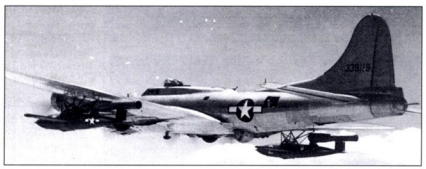
With thousands of B-17s surplus to requirements at the end of the war, one use to which they could be put was as remotely-controlled target drones or sampling aircraft for atomic weapons testing. DB-17s were used as 'mother' ships to control the QB-17 drone aircraft. The last active B-17 in the USAF was brought down by a missile in 1960.

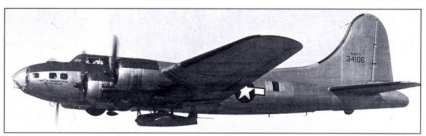
Above: A QB-17G of the 58th BW is prepared for its part in Operation Crossroads, the first Bikini Atoll atomic bomb test, 1 July 1946. Stripes enabled the drone directors to identify their charges. B-17 drones were originally designated BQ-7 and their directors as CQ-4s.

Left: The drones used in Crossroads flew into the atomic cloud fitted with air sampling bags to measure fallout, cameras and some radio equipment being tested against blast effects.

Testbeds

The B-17 proved a popular basis for conversion to a flying testbed due to its inherent stability and carrying capacity. The military, government and aerospace companies all used the B-17 for weapon and other tests.



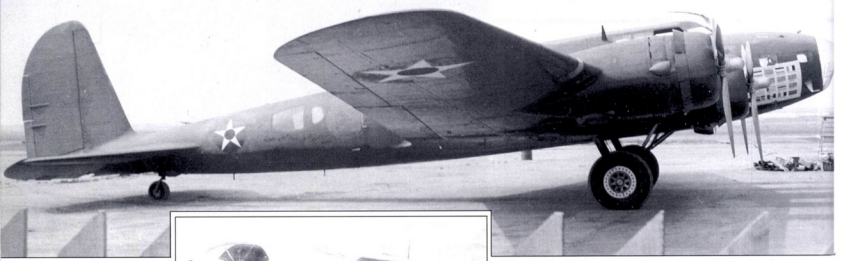


Left: This MB-17G was used in 1945 to launch JB-2 Loon 'buzz-bombs' over a range at Wendover, Utah. This aircraft unusually retains gun armament, unlike the DB-17s later used to launch these captured V-1 missiles.

Far left: This B-17G was retained by Douglas for weapon development and is seen toting a pair of ROC missiles.

Left: The first USN B-17 was a B-17F-75-DL acquired in 1943 and designated PB-1U. Among a variety of tasks, it was used to carry a radio-controlled one-quarter-scale F8F Bearcat for drop tests

VIP Fortresses



The first Flying Fortresses used for long-range VIP transports tended to be locally-converted war-weary bombers. General MacArthur's *Bataan* was so extensively modified, however, that it was felt deserving of a new designation: C-108. Only two C-108s were completed as VIP transports, but a similar standard was applied to the VB-17, some of which were converted CB-17 troop-haulers. There was no set standard for these aircraft, with differing window and door configurations appearing. Likewise, interiors exhibited varying degrees of plushness.

The earliest Fortress to become a general's runabout was B-17D 40-3097* The Swoose. *Put together from parts of many wrecked 19th BG B-17s, like Alexander the Swoose of a popular song, it was 'half swan, half goose'. Becoming the personal transport of General George Brett, it visited over 35 countries and is today stored for the National Air and Space Museum. It is the only surviving 'shark-finned' B-17.

Left: General MacArthur's XC-108 set the standard for B-17 'flying offices' with a galley, bed space, wardrobe and swivelling airline-style seats. The bomb bay and all armament, except for a chrome-barrelled nose gun, was deleted. Originally a B-17E, the XC-108 had a modified B-17F nose piece without the bombardier's flat panel.

B-17s served in small numbers throughout the Korean conflict. This VB-17G belonged to the Far East Air Logistics Force and was seen at Taegu in 1953.

Above: 44-6393 was one of the 26 CB-17Gs recorded on USAAF strength in 1946, later serving as seen here with the US embassy in Canada. It went on to serve until 1990 as a freighter in Bolivia, crashed and was then rebuilt before donation to the USAF and display at the March Field museum.

secret', and details of its operation came to light only some years after the end of the war in Europe. Project Aphrodite was ordered in June of 1944 during the period in which England was under attack by V-1 rockets whose launching sites were in the Pas de Calais area of France. To combat this menace, it had been suggested that war-weary B-17Fs and Gs could be made available as pilotless radio-controlled aircraft; they could be loaded with high explosives and guided to targets in order to destroy the rocket launch sites.

This SB-17G, of MATS, without lifeboat but retaining undernose radar, was seen at Itazuke, Japan in 1952.

All armour, turrets, bombing and oxygen equipment were removed, as well as the co-pilot's seat. The BQ-7s, as the aircraft were designated, were crewed by only two people: a pilot and his radio engineer. Radio receivers were linked to the autopilot system through which the aircraft could be controlled from a 'mother' aircraft. The majority of the 10 aircraft originally modified were loaded with 20,000 lb (9070 kg) of TNT. The plan called for the two-man crew of the 'baby', or radio-controlled aircraft, to take off and set the aircraft on its course, and then bail out. The 'mother' aircraft would then take over and radio technicians would guide the drone to its target.

Unsuccessful operations

The first of these operations was launched on 4 August 1944, with two 'babies' launched. Both aircraft were doomed to failure. One BQ-7 went out of control and into a spin; the crew bailed out but the pilot was killed. The first crew bailed out successfully and the 'baby' made it across the Channel, but control was lost on descent and the aircraft crashed some distance from the target.

The US Navy's Special Air Unit also became involved the project and operated under the codename Anvil. Its efforts also came to nothing.

The USAAF attempted additional missions using drones with more precise radio equipment. By the time this project got underway, the French coast had been overrun by Allied troops and targets were sought in Germany. Some

B-17G N66573 was a memorial tended by the Polo, Illinois Boy Scouts when it was purchased by California Atlantic Airways in 1952. Restored to fly, it joined Fairchild Aerial Survey, with whom it is seen here. Still painted in this striking scheme and dubbed* Batmobile, *it became a fire-bomber in 1961. It was sadly lost with both crew when it crashed on Cayuse Saddle, Montana in 1979.

of these missions might have been effective if the drones had not gone in at such a low altitude that they became victims of flak. All in all, the use of the B-17 as a drone was unsuccessful.

Other mixed batches of B-17s were redesignated F-9 as photo reconnaissance aircraft. For the most part, some armament and armour was retained in these models, which had K-22, K-17F or K-17 cameras mounted in the nose, the radio room and in the tail of the aircraft.

Captured Fortresses

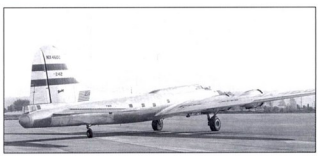
A number of B-17s fell into enemy hands and were used for testing and other purposes. It is known that the Japanese recovered a B-17E in the Philippines and got it back into flyable condition, but little is know of just what use was made of it.

The Germans reconditioned a number of B-17s which had crash-landed due to battle damage and got them back in the air. They used some in teaching fighter tactics. A former Me 262 pilot says that they discovered that when attacking the Fortress from above, they could zoom out, and the Sperry computing sight was not fast enough to track them. Other German Fortresses are believed to have come in parallel to the American formations and radioed course and altitude to the flak batteries.

Air-sea rescue duties

In early 1945 the Eighth Air Force assigned a number of B-17Gs to air-sea rescue duties. These aircraft carried a 27-ft (8.2-m) Higgins A-1 lifeboat. The 3,000-lb (1360-kg) boats were fitted with two motors and survival gear. The boat would descend on three parachutes until it hit the water, upon which rocket-propelled string lines were automatically ejected to assist those in the water. The only inconvenience for the crew of these B-17Hs was that the boat covered the nose hatch of the aircraft.

Below: The Institut Geographic National (IGN) operated a total of 13 B-17s between 1947 and 1989 on aerial survey work around the world. A number of them were 8th AF veterans, including F-BEEA, seen over Ireland in 1971.



Left: The first post-war civil conversion was Boeing's own 'Fortress Executive'. Not certifiable for regular passenger use, NX4600/ NL1B, the only conversion, was used by TWA on route-proving trips in the Middle East before being presented to the Shah of Iran as EP-HIM in 1947. It later passed to the IGN and was scrapped in 1970.

***Left: Although the FAA would not certify the B-17 for airline use, nine such aircraft operated in Sweden in the mid to late 1940s. All the B-17s were 8th AF aircraft interned after seeking sanctuary in Sweden with battle damage and were transferred to the government in exchange for repatriation of aircrew. Five of the B-17s were given names. This is* Ted, *the others were* Sam, Jim, Tom *and* Bob.

Left: B-17E CF-ICB was one of two Fortresses operated by Kenting Aviation on survey work, including the mapping of Baffin Island in 1957. It was discovered in Bolivia in the 1980s and is being rebuilt to fly by Scott Smith in Colorado.

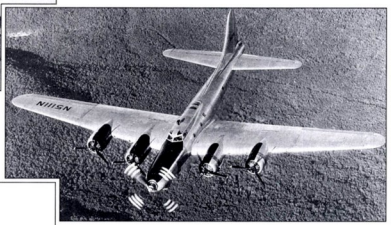
Below: One of about 30 Latin American civil Forts, B-17F HK-580 was the only Colombian-registered one. It was used for transporting prisoners to a remote jail.

Five-Engined Fortresses

With four engines for safety and a roughly circular nose cross-section, the B-17 made a suitable platform for aerial testing of new engines. Boeing converted two B-17Gs to accept different piston and turbine powerplants under the designation Model 299Z in 1947/48.

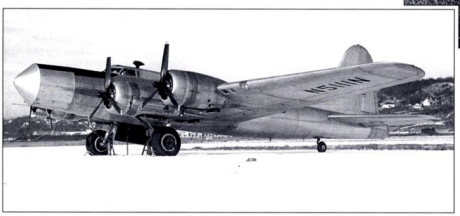
Left: Another Wright engine tested on N6694C was the XT-35 Typhoon, which was rated at 5,000 hp (3723 kW) – more than enough to keep the B-17 aloft on its own.

Above: N6694C was converted by Boeing-Wichita and its cockpit was moved 47 in (0.12 m) aft to maintain centre of gravity. Here it has an R-3350 fitted.



Below: For its ferry flight to the Pratt & Whitney facility, N5111N was fitted with this huge fairing over the centre engine mount. The other 299Z retained its (much blunter) fairing after it was sold on for fire-bombing.

Right: With a 5,500-hp (4096-kW) P&W XT-34 turboprop turning up front and all four Wright Cyclones feathered, N5111N gathers more test data. This aircraft served for 20 years before going to a museum.

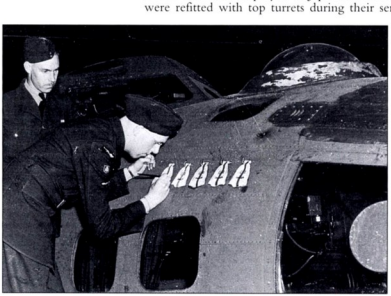


After the end of the war in Europe a number of B-17Hs were deployed to the Pacific and were involved in saving a number of B-29 crews during the air war over Japan. The Hs remained in service after World War II and served in a number of air-sea rescue squadrons. Radar installations for search were fitted where the chin turrets had been and the new designation for the aircraft was SB-17G. The SB-17G served with units deployed to Japan and Korea, and some were refitted with top turrets during their service. These aircraft served in air-sea rescue units until the mid-1950s.

Following the success of the US Army Air Force with air-sea rescue B-17s, the US Coast Guard acquired 16 new Vega-built B-1Gs from storage depots in early 1946. Designated PB-1Gs, the aircraft were used primarily for long-range air-sea rescue, but they were also employed as iceberg patrol and high-altitude mapping. In 1946 the Coast Guard had a number of B-17s reworked to B-17H configuration with Higgins A-1 lifeboats, and search radar mounted below the nose.

In 1953 the US Coast Guard had PB-1Gs based at five of their installations: five at Elizabeth City, North Carolina, two at San Francisco, two at Argentia, Newfoundland, one at Annette Isle, Alaska and one at Port Angeles, Washington. One of these aircraft became the last military B-17 operating in US service. Former B-17G-110-VE (44-77254, PB-1G BuNo. 77254) was retired at Elizabeth City in October 1959.

Several B-17s were turned over to engineering services, both military and civilian, to test new and revolutionary types of aircraft powerplants. One of the more notable was



Left: One of the least-known B-17 operators was Canada, who used five aircraft during the war years for transport of mail to forces overseas. Here an airman paints on a mailbag, signifying another Atlantic crossing.

Below: The nascent state of Israel operated three clandestinely-obtained B-17Gs from 1947-1958. Later equipped with turrets, external bomb racks and chin radar, these were almost certainly the last Flying Fortresses to drop bombs in anger.

The Brazilian air force operated 12 SB-17Gs from 1951 on SAR and, later, transport duties. Aircraft 5402 and 5408 are preserved in Brazil, while 5400 was donated to the USAFM in 1968 and is displayed at Hill AFB, Utah.

the Wright Aeronautical Corporation's testing of its 5,000-hp (3750-kW) turboprop engine. Boeing designated this aircraft 299Z. The XT-35 engine was mounted in the nose, and to keep it from being too long the flight deck was set back several feet. The massive engine was capable of powering the aircraft with all four of the conventional engines shut down and the propellers feathered.

Another interesting testbed project was the modification of a B-17G-105-VE which in 1954 was fitted with a 3,750-hp (2810-kW) Allison T-56 turboprop engine in the nose.

During World War II the USAAF had developed the BQ-7 drones for Project Aphrodite, as described earlier. In 1946, when the atomic testing programme Operation Crossroads was being established, it was decided to resurrect the B-17 drone programme for radiation testing following the detonations. A worn B-17 was fitted with new, refined radio-control systems at Clovis Field, New Mexico, and over six weeks of testing it was shown that the new drone responded beautifully. Ten B-17s were immediately withdrawn from storage and fitted out with radio, television and other related equipment. Another six B-17s were fitted out as 'mother' aircraft to control the drones.

In June 1946 the aircraft were flown to Eniwetok Atoll in the Pacific to take part in the tests. Following the atomic explosion in July 1946, the drones were used to fly near and through the mushroom clouds for sample collecting and for atmospheric testing. The success of this programme led to the establishment of drone squadrons. The drones became QB-17Gs and the director aircraft became DB-17Gs.

A further deployment of the drones and directors was made when more atomic tests were run in the Pacific in 1952. Drone squadrons were established in Florida, New Mexico and California for various types of air-to-air and ground-to-air missile testing. As time went on, additional B-17s were brought from storage. The last drone fell to a missile in August 1959.

Airline duty

Although the B-17 had a capacity for heavy loads, there was not much space in the fuselage for airline-style seating. TWA obtained one B-17G but it was converted for executive duties. They used the aircraft, NX4600, to fly their executives around the Middle East when they were studying new routes following the war.

Many damaged B-17s had sought refuge in neutral Sweden during the war, and from late 1943 to early 1944 nine were donated to the Swedish government. The aircraft were stripped on the inside, the nose lengthened by 3 ft (0.9 m) and seats for 14 passengers were installed. The bomb bays were modified to accommodate 4,400 lb (1815 kg) of freight. At the end of the war two of the aircraft were transferred to Denmark, two were kept for spare parts and five became part of the Swedish airline.

Tankers and sprayers

The first B-17s to be converted to fire-fighting tanker aircraft were modified in 1960. Two of the first operators were Aviation Specialities and Fast Way Air Service in California. The aircraft were fitted with tanks holding 2,000 US gal (7570 litres) of fire retardant. Most of these

Left: Portugal operated a similar number of SB-17Gs from Lajes, scene of much B-17 history. One aircraft had been impounded on its way to Israel in 1948.

firms contracted out their tankers for use to the US Forest Service.

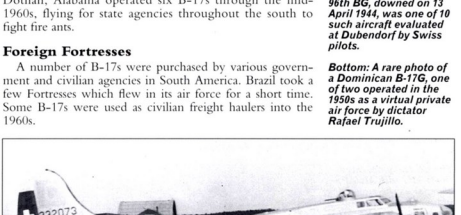
A number of firms became owners of fire-fighting B-17s over the years and they continued to operate into the 1980s. The only thing that finally grounded the Boeing fleet was absence of spare parts and rising doubts about the structural soundness of the aircraft. When the fire retardant capacity was cut to 1,800 US gal (6815 litres) and the contract called for 2,000-US gal tankers, the B-17s were put out of business.

A number of B-17s were fitted with insect spray tanks and used to combat gypsy moths. Dothan Aviation of Dothan, Alabama operated six B-17s through the mid-1960s, flying for state agencies throughout the south to fight fire ants.

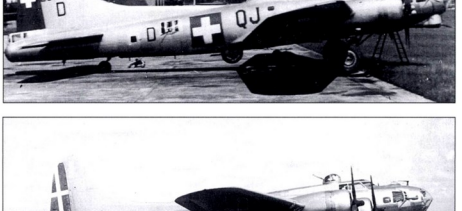
Foreign Fortresses

A number of B-17s were purchased by various government and civilian agencies in South America. Brazil took a few Fortresses which flew in its air force for a short time. Some B-17s were used as civilian freight haulers into the 1960s.

Below: The Swiss were, like the Swedes, recipients of damaged USAAF B-17s seeking safety in neutral territory. 'QJ-D' of the 96th BG, downed on 13 April 1944, was one of 10 such aircraft evaluated at Dubendorf by Swiss pilots.

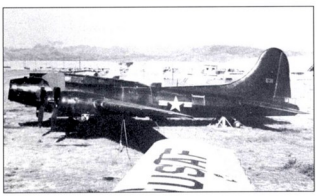


Bottom: A rare photo of a Dominican B-17G, one of two operated in the 1950s as a virtual private air force by dictator Rafael Trujillo.



Clandestine Operations

Right: This mysterious all-black B-17 (RB-17G 44-85531) arrived at Clark Field in the Philippines in October 1957. Said by some to have previously operated with the Nationalist Chinese over mainland China and with the CIA over Indochina (Vietnam), the full story of its missions remains unknown. Exhaust suppressors, undernose antennas and added oxygen equipment were some of the special items noted on the aircraft.



The black B-17 had a sliding tray on the fin, allowing the three-digit tail number to be changed. The aircraft stopped flying in December 1957 and its windscreen, carburettors and other parts were sent to Wright Field, suggesting possible contamination.

This civilian-schemed ex-VB-17G, N809Z, was photographed at Phoenix in 1961. Owned by Atlantic General Enterprises of Washington, DC and then Intermountain Aviation of Marana, Arizona, a known CIA front company, it was possibly the first aircraft equipped with the Fulton personnel-recovery system. It appeared at the end of the James Bond film **Thunderball** *and, following a career as a fire-bomber, has been restored to wartime configuration by Evergreen at Marana which flies it as N207EV,* **Shady Lady.**

Nationalist China flew a number of black B-17s from Formosa for some years. These aircraft undoubtedly were used for all short clandestine missions over the mainland.

Even the US CIA got in on the B-17 act. There are existing photos of B-17s fitted with aerial pick-up devices on the nose and padded exits at the rear of the aircraft.

The B-17 returned to combat once more before the end of its career. Three Fortresses made their way to Czechoslovakia via clandestine methods to join the new Israeli air force, which was fighting for that country's independence. On the morning of 14 July 1948, the three aircraft took off from Czechoslovakia for Tel Aviv, bombing Cairo and a base in the Sinai desert on the way. These Fortresses had been stripped of all their armament. They had no turrets, no armour, no Norden bombsight and no aircraft-type machine-guns. Two Czech light machine-guns were mounted in the waist and two in the nose. Some crew members were armed with sub-machine-guns. The bombsight was a small artillery sight.

Only one of the bombers struck Cairo, for two had no oxygen equipment. The bomber went over the Egyptian city and dropped a few German 50-kg (110-lb) bombs, which incidentally missed King Farouk's palace. The other two Fortresses bombed a military base at Rafah. There they encountered anti-aircraft fire before they could drop their bombs, which had a tendency to hang up in the make-shift racks that held them. The crews reported they did some damage and proceeded on to their new base at Tel Aviv.

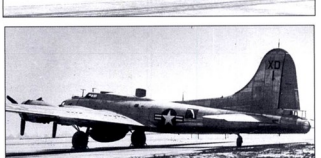
Over the next few months the crews flew at least 15 more missions against Egypt and Syria. During the Israeli offensive from 9 to 19 July 1948, the three Fortresses carried the brunt of the Israeli bombing as the first official bombardment squadron.

Movie star

The Boeing B-17 starred in a number of movies from its inception up to just a few years ago. Its first role was in the movie *Test Pilot* made by MGM in 1938. All 12 YB-17s from the 2nd Bombardment Group took part. Lieutenant Colonel Robert Olds brought his entire Flying Fortress strength cross-country from Langley Field, Virginia, for the screening.

The next billing for the Fortress took place in *I Wanted Wings*, a Paramount picture made in 1941. Some final scenes in the movie employed B-17Bs from the 19th Bombardment Group based at March Field, California.

The US Navy operated the B-17G with AN/APS-20 radar as the ancestor of today's AWACS under the designation PB-1W. Armament was removed, but provisions for refitting it (including keeping the upper turret ring) were retained.



Right: PB-1s remained unpainted longer than other land-based USN aircraft as the VX-4 commander preferred it that way. BuNo. 77235 flies today as **Texas Raiders** *with the CAF.*

Far right: PB-1W 77234 was modified in 1950 with radar fitted above the fuselage. Assigned to VW-2, it was detached to Gardamoen, Norway in mid-1952.

Fire-bombers

B-17 fire-bombers required increasing maintenance as they got older. Eventually, a lack of spares and new regulations grounded the last ones around 1985. Tanker C17, however, seen here in 1979, flies on as **Sentimental Journey.**

Below: In 1954, B-17F N17W became the first Fortress equipped for pest spraying. This photo was taken from a rooftop in (gypsy moth-infested) Lansing, Michigan.

Above: A B-17 tanker of Aero Union drops 1,800 US Gal (6813 litres) of borate fire-retardent in 1971. Twenty-three B-17s were converted to fire-bomber configuration.

Below: N17W became the only B-17F converted to the fire-bomber role. In 1979 it was Tanker 04 with Aircraft Specialties of Arizona when seen at Porterville, CA.

The B-17 was really the star of Warner Brothers *Air Force* in 1943. This portrayal of the beleaguered USAAF in the Philippines in 1941-42 gathered the attention of all America and became one of the best known films of the war years. Ten B-17Cs and Ds from Hendrick Field at Sebring, Florida along with their flight crews took part in the filming of the feature.

A few B-17s based at Kirtland Field, New Mexico, had roles in *Bombardier* from RKO in 1943, but the real Flying Fortress film of the war was a documentary directed by Lieutenant Colonel William Wyler in 1944. *Memphis Belle* is still considered one of the finest documentaries from World War II. It also brought much undivided attention to the plight of the aircrews attempting to prove that daylight bombing could be performed in the face of the Luftwaffe over Europe.

Right: N66571, Tanker 09, was donated to the National Air and Space Museum four years after this 1978 picture taken at the Alamogordo base of operator Black Hills Aviation.

Below: TBM Inc. of Tulare, California operated N3703G from 1969 to 1982. It is now a warbird owned by David Tallichet's Military Aircraft Restoration Group.

Post-war stardom

The Fortress flew off into oblivion like all the World War II aircraft until a film entitled *Command Decision* was made by MGM in 1948. This is a portrayal of the command of a B-17 bomber unit during the early days of the 8th Air Force in England.

Perhaps a better portrayal, and certainly more action, is found in *Twelve O'Clock High* made by Twentieth Century Fox in 1949. By this time B-17s were getting hard to find, but fortunately six were available from the 3205th Drone Squadron at Eglin Field, Florida, to add to the six others available. The six drones were veterans of the Bikini exercises and had to be periodically checked for radiation during the filming.

Another laudable film featuring the Fortress came along in 1962 with Columbia's release of *The War Lover*, a portrayal of a B-17 pilot obsessed with the glory of being a bomber pilot. Three restored B-17s were flown from Tucson, Arizona to England, where the movie was made.

The next Flying Fortress Eight Air Force portrait came in 1969 with United Artists' *The Thousand Plane Raid*.

Seen departing Dover AFB, Delaware, where it had undergone an eight-year restoration, B-17G* Shoo Shoo Shoo Baby*, veteran of the 91st BG, Swedish airlines, the Danish Air Force and the IGN, made one last flight to the US Air Force Museum, October 1988.

Above: Film company weathering and attention to detail made the four B-17Gs (N3703G, G-BEDF, F-AZDX and F-BEEA) and B-17F (N17W) convincing facsimilies of 1943 91st BG B-17Fs. With markings that changed daily, the aircraft are difficult to identify.

Memphis Belle

In the summer of 1989, the skies of East Anglia once again reverberated to the sound of B-17 formations as production of David Putnam's *Memphis Belle* got underway. Five flyable aircraft were gathered together for the film, a fictionalised version of the wartime documentary: two from France, one from the UK and two flown across the Atlantic by their American owners. Up to seven P-51 Mustangs provided escort and three Hispano Buchons (Me 109Js) the aerial opposition. Air-to-air filming took place from Duxford during June and July before the production moved to the ex-RAF bomber base at Binbrook for shooting of take-offs, landings and ground scenes. Painted 'flats' and large-scale models were used to create the illusion of a full B-17 group *circa* May 1943.

Above: Lined up at Duxford between takes are the B-17s that starred in **Memphis Belle***. The nearest aircraft is the British* **Sally B** *in one of its many film guises. There were in fact six B-17s at Duxford, the other being the IWM's static* **Mary Alice.**

The last 'working' Fortress, **F-BEEA, Chateau de Verneuil,** *which had served with the IGN since 1947, was sadly destroyed in a take-off crash at Binbrook. Fortunately, the 10 people aboard escaped without serious injury.*

N17W, veteran of **Tora Tora Tora** *and* **The 1,000-Plane Raid,** *needed the least work to represent a wartime B-17F. Clever application of reflective material represented holes torn in the fin structure.*

Although filmed in colour and featuring some nicely restored B-17s, the film did not do well at the box office.

The Fortress may have enjoyed its last taste of stardom in 1990 with the appearance of *Memphis Belle* by Warner Brothers. Filmed in England in colour and featuring five B-17s, the movie was well received by a younger generation but was criticised by the old crew members. The most redeeming feature for them was the beautiful flight sequences in colour.

Survivors

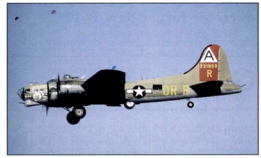
The most noted B-17 still in existence is *Memphis Belle*, which is on static display on Mud Island, in Memphis, Tennessee. The 'Belle' is B-17F serial number 41-24485.

The Confederate Air Force features two flyable B-17s: *Texas Raider* B-17G serial number 44-83872 based at Midland, Texas, and *Sentimental Journey* B-17G serial number 44-83514 based at Mesa, Arizona.

Another beautifully restored and flyable Fortress is

Of the 12,726 Flying Fortresses built, approximately 43 survive in 1997 in some state of preservation. Another half-a-dozen await recovery in lakes, swamps and under ice caps around the world. Further aircraft may rise again from ambitious restoration projects underway in various parts of the US. Thirteen aircraft are still capable of flight, all originally B-17Gs or their derivatives; only one is a known combat veteran.

Miss Angela: ***N3509G ex-VB-17G and fire-bomber Bob Pond, Minneapolis, Minnesota.***



Nine-O-Nine: ***N93012 ex-SB-17G Collings Foundation, Stow, Massachusetts.***

Aluminum Overcast: ***N5017N B-17G ex-crop sprayer. EAA Aviation Foundation, Oshkosh.***

Chuckie: ***N3701G ex-JTB-17G testbed and sprayer. 'Doc' Hospers, Fort Worth, Texas.***

Sally B: ***G-BEDF ex-ETB-17G and IGN. B-17 Preservation Ltd, Duxford, UK.***

Sentimental Journey: ***N9323Z ex-DB-17P and fire-bomber. Confederate AF, Mesa, Arizona.***

Thunderbird: ***N900RW B-17G ex IGN. Lone Star Flight Museum, Galveston, Texas.***

Texas Raiders: ***N7227C ex-PB-1W and air survey, Confederate Air Force, Midland, Texas.***

***The Confederate Air Force operate two B-17s,* Texas Raiders *(front) and* Sentimental Journey.**

Memphis Belle: ***N3703G ex-VB-17G and fire-bomber. David Tallichet, Chino, California.***

Fuddy Duddy: ***N9563Z ex-VB-17G and fire-bomber. National Warplane Museum, New York.***

Shady Lady: ***N207EV ex-VB-17G, CIA 'skyhook' aircraft and fire-bomber. Evergreen Heritage Collection, Marana, Arizona.***

Mother and Country/Pink Lady: ***B-17G F-AZDX ex-8th AF 303rd and 351st BGs and IGN. Association Fortresse Toujours Volant en France, Paris-Orly.***

Thunderbird B-17G serial number 44-85718, which belongs to the Lone Star Flight Museum at Galveston, Texas.

Other flyable B-17s on the air show circuit in the United States are Collings Foundation's B-17G serial number 44-83575 which flies as *Nine-O-Nine*, Vintage Flying Machines' B-17G serial number 44-8543 *Chuckie* out of Ft Worth, Texas, and EAA Aviation Foundation's B-17G serial number 44-85740 from Oshkosh, Wisconsin flying as *Aluminum Overcast*.

Well known in the skies over Great Britain is *Sally B*, which is B-17G serial number 44-85784, operated by B-17 Preservation Ltd at Duxford.

One of the most publicised and completely restored static display Fortresses is *Shoo Shoo Baby* at the Air Force Museum in Dayton, Ohio.

William N. Hess

B-17 Military Operators

The B-17 was the second most numerous US bomber and it served in almost every part of the globe with the US Army Air Forces. Post-war, the new USAF, Navy and Coast Guard added to the B-17's roll of honour. Like most US strategic bombers it was not widely exported, although a half-dozen air forces flew B-17s, mostly in small numbers.

USAAF Combat Groups

Pacific Theatre

5th, 7th and 13th Air Forces

5th Bombardment Group

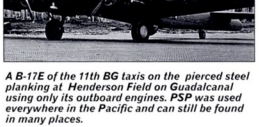
'Kiai o ka lewa' (Guardians of the Upper Regions)

Based in the Hawaiian Islands from 1919, the 5th Bombardment Group had both B-17Ds and B-18s by 7 December 1941, and lost many of their aircraft in the Japanese attack on Hickam Field. For the next 11 months the group flew patrol missions around the islands. In November 1942 the group moved to Espiritu Santo in the Solomons and, with a mix of B-17s and B-24s, the group fought in the Solomons and Philippines campaigns as part of the 13th Air Force. After the war the 5th BG remained in the region, but by early 1946 all personnel had been withdrawn. Remanned in March 1947, and renamed the 5th Reconnaissance Group, the unit conducted mapping flights in the Philippines and over Formosa; it was equipped with F-10 Photo Fortresses until May 1949. The group returned to the US and briefly became the 5th Strategic Reconnaissance Group before trading in its B-17s for RB-29s in July 1949.

7th Bombardment Group

'Mors ab Alto' (Death From Above)

The 7th BG was formed on 1 June 1928 and by 1939 was equipped with a variety of aircraft types, including B-17s. Six of the group's B-17Es arrived at Pearl Harbor on 7 December 1941, en route to joining B-17Cs and Ds already based in the Philippines, and they fortunately survived the Japanese attack. Flying on to Java and receiving more B-17Es, the group attacked Japanese airfields, shipping and bases in the Netherlands East Indies and the Philippines, often in formations of less than 10 aircraft due to poor serviceability. Upon the US surrender in March 1942, the few surviving aircraft moved to India as part of the 10th Air Force. 7th BG B-17 operations against the Japanese continued until the end of the year when the group converted to B-24s.



A B-17E of the 11th BG taxis on the pierced steel planking at Henderson Field on Guadalcanal using only its outboard engines. PSP was used everywhere in the Pacific and can still be found in many places.

11th Bombardment Group

'Progressio Sine Timore Aut Praejudicio' (Progress without fear or prejudice)

Like the 7th BG, the 11th flew its first operational missions with B-17s on patrols from Hawaii following the Japanese attack. The group had received B-17Ds and Es during 1941 but only had 10 aircraft available on 7 December. Flown to Midway Island as a result of code breakers predicting a Japanese invasion, group aircraft attacked enemy naval surface forces during the Battle of Midway, but with little material effect. The group moved to the New Hebrides in July 1942. As the only heavy bomber group in the central Pacific at that time, the group struck airfields, shipping and installations in the Solomons until March 1943, when it returned to the US for conversion to the B-24.

19th Bombardment Group

'In Alis Vincimus' (On wings we conquer)

Based in Philippines with B-17Cs and Ds at the outbreak of war, most of the 19th GB's aircraft were lost in air attacks or in attempts to stem the Japanese advance. Like the 11th BG, the 19th was receiving new aircraft via Hawaii when war broke out. The remnants of the group withdrew to Australia, then at the end of 1941 went to Java, where it attacked the Japanese forces in the Philippines and evacuated General MacArthur and his staff when the Philippines fell. Subsequently, the 19th BG participated in the Battle of the Coral Sea and attacked the forces invading New Guinea. Captain Harl Pease was posthumously awarded the Medal of Honor for a mission during this period. In late 1942, the group returned to the US and became a replacement training unit before disbandment and reformation as a B-29 unit in April 1944.

One of the 19th BG's most famous aircraft was Suzy Q of the 93rd BS. Those few B-17Es that survived the Pacific campaigns had often flown more missions than their counterparts in Europe.

43rd Bombardment Group

'Willing, able, ready'

Beginning the war with a mix of aircraft flying anti-submarine patrols off the New England coast, the 43rd BG joined the 5th Air Force in the Pacific in March 1942, flying its B-17Es via Cape Town to Australia. For several months, the group flew no missions, as its aircraft and crews were absorbed as replacements for the 7th and 19th BGs. When its B-17s (including some Fs) did see action, it was mainly in the anti-shipping role, and the group was credited with the destruction of a Japanese convoy in the battle of the Bismarck Sea in March 1943.On 16 June 1943, pilot Captain Jay Zeamer and bombardier Joseph Sarnowski were awarded Medals of Honor (the latter posthumously) for completing a photo mission despite heavy fighter attack. During the period May-September 1943, the group transitioned to B-24s.

An anonymous B-17F (or possibly an E refitted with a new nosepiece) of the 65th BS, 43rd BG at Mareeba, Australia, November 1942. Pacific Theatre B-17s had no identifying group markings.

European Theatre

8th Air Force

34th Bombardment Group

'Valor to Victory'

The 34th BG trained on B-17s and conducted early war patrols off the East Coast, subsequently becoming a West Coast defence unit. The group entered combat from England in May 1944, but equipped with B-24s as part of the 93rd Bomb Wing, 3rd Air Division. Receiving B-17Gs in September 1944, the 34th BG flew missions against Germany from Mendlesham until the war's end, disbanding upon its return to the US in August 1945. The 34th BG did not carry an individual group letter but was distinguished by the painting of the forward half of the fin red, with a red band around the tailplanes and wings. Each squadron was identified by a coloured nose band.

B-17Gs of the 34th BG fly with gear down over a flooded area of Holland during a 'Chow Hound' food drop in April 1945. German forces had breached dykes, causing food shortages. These were the last 8th AF bomber missions.

91st Bombardment Group

Formed in the US in April 1942 with B-17Fs, the group trained until August when it moved to Kimbolton in England. Soon moving to Bassingbourn, the 'Ragged Irregulars' remained there until the end of the war, and suffered the highest losses of any 8th Air Force group. The 91st led the famous Schweinfurt raid of 17 August 1943 and was heavily involved in supporting the Allied advance after D-Day. Famous group aircraft included *Memphis Belle* and *Nine O Nine*. Distinguished Unit Citations were awarded to the 91st BG for leading the first Schweinfurt mission and for a January 1944 attack on Oschersleben. Inactivated at the end of 1945, the group was reactivated as the 91st Reconnaissance Group in 1947 and operated B-17s – among other types – until 1952. As part of the 1st Bombardment Wing (BW), 1st Bombardment Division (BD), the 91st aircraft wore a triangle insignia on the fin within which was the letter 'A'. A broad red band appeared on the fin centre-section from July 1944, and wingtips and tailplanes also became red.

Old Battle Axe *of the 323rd BS, 91st BG served from August 1944 until the end of the war. Suffering battle damage in November, the B-17G was refitted for the RCM role.*

92nd Bombardment Group

'Higher, Stronger, Faster'

The 92nd Bomb Group, nicknamed 'Fame's Favored Few', was formed in January 1942 and flew anti-submarine patrols from Florida after the completion of training. The first bomb group to fly the Atlantic non-stop, it was initially based at Bovingdon but moved to Alconbury and then Podington during 1943. Flight Officer J. C. Morgan of the 326th BS received the Medal of Honor for a mission in July 1943 when he brought his B-17F back to England while struggling against his mortally wounded pilot who was gripping the controls. At the end of hostilities in Europe, the 92nd undertook many personnel repatriation flights from North Africa and was disbanded by absorption into the 306th BG in February. 'Triangle B' was the group marking for the 92nd BG, later supplemented by a red band across the fin (from August 1944).

B-17Gs of the 325th BS, 92nd BG display late war markings including coloured horizontal control surfaces, group letter above the starboard wing and red band across the vertical fin.

94th Bombardment Group

'Cunning-Rugged-Courageous'

Activated on 15 June 1942 for service in Europe, the 94th trained on B-17s, becoming operational at Earls Colne in May 1943. After a month the group moved to Bury St Edmunds for the duration of the war, during which it won two Distinguished Unit Citations, including one for the 17 August 1943 Regensburg mission. After the war the group spent the remainder of 1945 on leaflet-dropping missions to civilians in Germany and the liberated countries. The group was inactivated in Europe just prior to Christmas 1945. 'A' in the 3rd AD square symbol was the 94th BG's marking, with the addition of a red chevron on the upper right/lower left wing, and a single red fuselage band after January 1945.

A 94th BG B-17F is seen over the Focke-Wulf plant at Marienburg on 9 October 1943.

95th Bombardment Group

'Justice With Victory'

The 95th was another of the groups formed in the first half of 1942 specifically for the 8th Air Force. It took its B-17Fs to Alconbury and Framlingham in the spring of 1943. Quickly moving to Horham, the group flew from there for the duration of the war and was awarded three Distinguished Unit Citations – the most for any 8th AF group. After flying its last combat missions at the end of April 1945, the 95th BG was assigned more humanitarian tasks, such as dropping food to Dutch civilians and repatriating prisoners from Austria. The group was disbanded upon its return to the US in August 1945. 'Square B' denoted the 95th BG, with the addition after January 1945 of red diagonal wing bands and a red band along the trailing edge of the rudder.

A B-17F-115-BO of the 95th BG's 336th BS drops its load on Germany. Note the red-bordered national insignia and the grey fuselage codes.

96th Bombardment Group

'E Sempre L'Ora' (It Is Always the Hour)

Activated on 15 July 1942, the 96th BG served as an operational training unit before departing for England in April 1943. The group flew its first mission from Andrews Field but spent most of the war at Snetterton Heath. The 96th led the Regensburg shuttle mission which flew on to Africa in August 1943, and was awarded a DUC for this mission plus another for a mission to Poznan in April 1944. The group dropped supplies to the French resistance as part of the Normandy campaign. Like the 95th BG, the 96th dropped supplies as part of the relief effort for starving Dutch civilians. It was involved in personnel transport duties until the end of 1945, when it returned to the US for disbandment. The letter 'C' in a square was the identifying marking of the 96th BG, although it was not worn by pathfinder aircraft. After January 1945, a pair of parallel red bands was painted across the upper right/lower left wings and across the tail fin.

A B-17F of the 'Bloody Hundredth' sits at the 1st Advanced Air Depot at Honington together with other B-17s awaiting armament modifications.

100th Bombardment Group

One of the most famous B-17 groups, the 'Bloody Hundredth' got its nickname after a number of severe maulings at the hands of the Luftwaffe. Known as the hard-luck outfit of the 8th Air Force, the 100th was in fact only third in terms of total aircraft lost (after the 91st and 96th BGs). Formed in the US in June 1942 and moving to Thorpe Abbots via Podington, the 100th flew an even 300 combat missions, winning a DUC for the Regensburg mission and another for attacks on Berlin in March 1944. The group was also awarded the Croix de Guerre with Palm by the French government for destroying German installations and for supply drops to French forces after D-Day. The 100th BG was identified by the letter 'D' within a square. Black diagonal wing bands (upper right/lower left) and a black rudder were additional distinguishing features from January 1945.

303rd Bombardment Group

'Hell's Angels'

The 303rd BG 'Hell's Angels' flew more missions than any other B-17 group in the 8th Air Force, a total of 364 in 30 months of combat from November 1942. The group had been formed in February 1942 and operated solely from Molesworth during its time in the UK. Two Medals of Honor were awarded to group members: posthumously to First Lieutenant Jack Mathies, lead navigator of his squadron, who accurately released his bombs despite mortal wounds; and to radio operator Technical Sergeant Forrest Vosler who, despite serious injuries, manned his gun and repaired his damaged radio, allowing a distress signal to be sent which saved the crew of his ditched B-17. The 303rd BG was briefly sent to North Africa to become part of Transport Command at the end of hostilities, but this plan was quickly reversed and the group was disbanded in July 1945 at Casablanca. The group marking was a 'C' within a triangle on fin and right wing. After August 1944, the triangle was bordered by a broad red band.

This Douglas-built B-17G of the 358th BS, 303rd BG crash-landed at Molesworth on 12 September 1944 after a mission against oil targets in Germany. Damage like this was usually repairable.

305th Bombardment Group

'Can Do'

Activated in March 1942 and trained in Utah, Washington and California, the 305th BG began operations from Grafton Underwood in September of that year. The group was awarded DUCs in April 1943 and January 1944, and two Medals of Honor went to First Lieutenants William Lawley and Edward Michael for actions which brought their damaged aircraft back to England in February and April 1944, respectively. In addition to day bombing, one squadron flew a small number of night missions in the autumn of 1943. Remaining in Europe after VE-Day, the group carried out photographic mapping missions over Europe and North Africa until October 1946. Finally deactivated on Christmas Day 1946 as part of USAFE, the 305th was (together with the 306th) the last B-17 Bomb Group in Europe.The 305th's group letter was 'G', displayed within the 1st AD's triangle, a symbol that was repeated on the underside of the left wing from spring 1944. A broad green band was added across the vertical fin during August 1944.

A B-17F of the 365th BS, 305th BG wears pristine olive drab/neutral grey camouflage. The red-bordered insignia was official only between 29 June and 14 August 1943, although examples of it could be seen long after the red was ordered changed to insignia blue.

306th Bombardment Group

'Abundance of Strength'

The 306th BG was activated on 1 March 1942 at Gowen Field, Idaho and began operations from Thurleigh on 9 October. Thurleigh was to be the group's only base for three years and seven months of combat, during which two DUCs and a Medal of Honor were awarded. The DUCs came for missions in January 1944, and during 'Big Week' the following month when the group pressed on to the target despite weather that forced back all other groups. Gunner Sergeant Maynard 'Snuffy' Smith received the Medal of Honor for saving his aircraft and crew on 1 May 1943 over St Nazaire. Remaining in England until December 1945, the 306th moved to Germany as part of the occupation forces and took part in Project Casey Jones – aerial mapping of Europe and North Africa. Run down during 1946, the 306th was finally disbanded as an organisation on 25 December. The 'triangle H' insignia of the 306th was worn on the fin of the group's aircraft from July 1943, repeated under the left wing from the spring of 1944. From August 1944 a plain or black-edged yellow band was worn across the fin.

Despite a fire in the starboard wing of this 306th BG B-17G, the pilot held it steady enough to complete the bomb run.

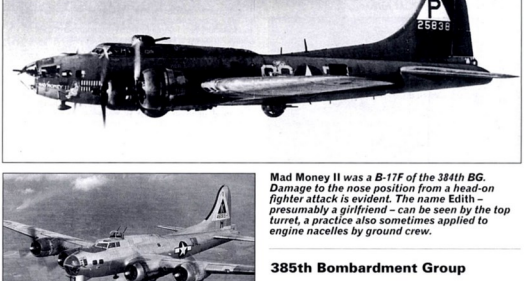
351st Bombardment Group

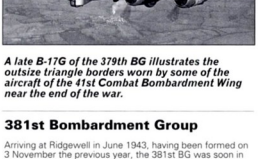
Based at Polebrook for the duration of its combat career, the 351st BG was formed on 1 October 1942, moving to England in May 1943. Among its 311 missions were two for which a DUC was awarded (9 October 1943 and 11 January 1944) and one for which two Medals of Honor were awarded to members of the same crew. Ball turret gunner Sergeant Archie Mathies and navigator Second Lieutenant Walter Treumper flew their damaged Fortress back from Leipzig to Polebrook on 20 February 1944, with their co-pilot dead and the pilot critically wounded. Attempting to land after the rest of the crew had bailed out, Mathies, Treumper and the pilot died when the B-17 crashed on the third approach. Just after VE-Day, the group returned to the US and was stood down on 28 August 1945 at Scott Field, Illinois. The 351st BG was distinguished by 'triangle J', with a diagonal red fin band added in August 1944. A large number of aircraft had nicknames incorporating 'ball', such as *Eightball* and *Fireball*, after squadron commander Major Clinton Ball.

At the war's end, worn-out B-17Gs such as this 351st BG aircraft lying near Munich were stripped of usable parts and scrapped by willing German manpower.

379th Bombardment Group

The 379th trained in the western US from its activation on 3 November 1942 until April/May 1943 when the group moved to the UK. Based solely at Kimbolton, the group dropped the highest bomb tonnage of any 8th AF group – 26,460 tons during its period in combat. The 379th won two DUCs, including one for the period 28 May 1943 to 21 July 1944. The group was ordered to French Morocco for transport duties at the end of the war but was not actually required, and its aircraft were returned to the US. The group was formally deactivated at Casablanca on 25 July 1945. When group letter identification markings were introduced in July 1943, that of the 379th BG was 'K' positioned within the 1st AD triangle. Later (from August 1944) the triangles, on wing and tail, were bordered by a broad yellow band.





A late B-17G of the 379th BG illustrates the outsize triangle borders worn by some of the aircraft of the 41st Combat Bombardment Wing near the end of the war.

Mad Money II ***was a B-17F of the 384th BG. Damage to the nose position from a head-on fighter attack is evident. The name* Edith –** ***presumably a girlfriend – can be seen by the top turret, a practice also sometimes applied to engine nacelles by ground crew.***

381st Bombardment Group

Arriving at Ridgewell in June 1943, having been formed on 3 November the previous year, the 381st BG was soon in combat. On the Schweinfurt mission of 17 August, the 381st suffered the heaviest losses of any group – 11 B-17s lost out of 26 dispatched. The group rebuilt and won two DUCs: for missions to Bremen on 8 October 1943, and against aircraft factories in Germany on 11 January 1944. Flying its last mission on 25 April 1945, the 381st quickly returned to the US and was disbanded on 28 August 1945.

The 381st's identifying letter was 'L', worn within a triangle. From July 1944, a broad red band that occupied most of the vertical fin was added as were red wingtips and red tailplanes (excluding the elevators).

The 381st BG is seen en route to Frankfurt during the late spring of 1944. Aircraft of the 532nd BS (foreground – VE codes) and 535th BS (MS) are visible.

384th Bombardment Group

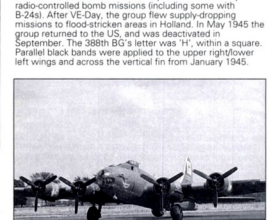
Activated on 1 December 1942 and training with B-17s, the 384th BG arrived at Grafton Underwood and began flying missions at the end of June 1943. During the group's 314 combat missions two DUCs were awarded, one for attacks on aircraft factories on 11 January 1944 and another for leading a 24 April 1944 mission to Oberpfafenhofen against heavy and effective opposition. On 25 April 1945, the 384th dropped the last bombs on a European target during the war, on a mission to Czechoslovakia during which one B-17 was lost; it was the last of 159 of the group's aircraft to fall on operations during the war. From the end of the war until February 1946, when it was deactivated, the 384th served on transport duties from Istres, France, including moving troops and repatriation of displaced persons. The 384th BG was identified by the letter 'P' in a triangle, which from August 1944 was bordered by a broad black band.

385th Bombardment Group

The 385th was nicknamed 'Van's Valiants' after their first commander, Colonel Elliot Vandervanter, who led the group from its formation on 3 February 1943 until 23 August 1944. The group received a DUC for its part in the Regensburg shuttle mission of 17 August 1943 and another for the bombing of an aircraft plant at Zwickau on 12 May 1944. Based at Great Ashfield during its time in combat, the 385th flew famine relief missions to Holland as part of Operation Chowhound in May 1945. The group moved to Sioux Falls, South Dakota in June and inactivated on 28 August 1945. The 385th group symbol from July 1943 was 'Square G', supplemented from late 1944 by yellow wing chevrons and, from March 1945, a red checkerboard pattern on the fin.

388th Bombardment Group

Activated in the US on Christmas Eve 1942, the 388th BG began combat operations from Knettishall with the B-17 on 17 July the following year. One month later, the group received a DUC for the Regensburg mission. Another was awarded for a series of missions that took place between 26 June 1943 and 12 May 1944 (many sources give this earlier date, although it predates group operations by 21 days). One of the group's more famous missions was the 21 July 1944 shuttle mission to Poltava, Russia during which 14 aircraft were lost in German bombing following a successful attack on oil plants at Ruhland. The 388th conducted the small number of 'Aphrodite' and 'Batty' radio-controlled bomb missions (including some with B-24s). After VE-Day, the group flew supply-dropping missions to flood-stricken areas in Holland. In May 1945 the group returned to the US, and was deactivated in September. The 388th BG's letter was 'H', within a square. Parallel black bands were applied to the upper right/lower left wings and across the vertical fin from January 1945.

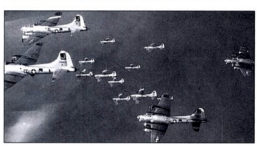


Homesick Angel ***was a B-17F-90-BO of the 388th BG. Metal areas on the fin and wing leading edges show where de-icer boots have been removed. While effective in combating ice accretion, the inflatable rubber boots were susceptible to tearing by flak fragments, causing a heavy drag penalty and loss of speed; they were usually removed at depot level.***

390th Bombardment Group

The 390th BG began life at Geiger Field, Washington on 26 January 1943 before moving to Framlingham in July. Five days after its first combat mission, the group took part in the Regensburg shuttle mission, for which it was awarded a DUC. Another DUC came for the 14 October Schweinfurt mission, during which only one aircraft was lost but all of the others were damaged. One of the crewmen of the 390th BG, Master Sergeant Hewitt Dunn, flew 104 missions, an 8th AF record. The group flew 300 missions and another six food-supply drops over Holland just before VE-Day, and was stood down in the US on 28 August 1945. The letter 'J' in a square was used to signify the 390th during its time in combat (the 390th arrived just as group symbols were introduced). Yellow bands – diagonal across upper right/lower left wings and down the rudder trailing edge – appeared from January 1945.

These Fortresses of the 390th BG are on the way to Regensburg. Yellow wing bands are visible on some aircraft. The nearest B-17G is from the 569th BS, and its partner is from the 568th BS.



398th Bombardment Group

The 398th BG was activated on 1 March 1943. The group worked up for combat on B-17s but was redirected to training replacement crews between July and December of that year. Assigned to Europe, the group moved to England and carried out its first combat mission on 6 May 1944. During its operational career, the 398th was based at Nuthampstead and flew only B-17Gs. Conducting mainly strategic operations, the 398th was diverted to a large number of tactical targets in the period from D-Day to the Rhine crossings in March 1945. At the end of hostilities, the group flew a prisoner repatriation missions from Germany and France. In May-June 1945, the group returned to the US where it was inactivated on 1 September. In early July 1944, the 398th BG added red wing tips, horizontal stabilisers and fin centre section to the group identifying letter 'W' in a triangle.

A B-17G of the 602nd BS, 398th BG displays the red tail surfaces worn by the group from July 1944. Elevators were usually left unpainted.

401st Bombardment Group

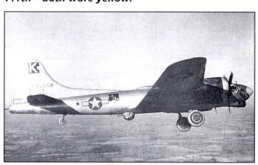
A B-17G with Cheyenne tail turret and staggered waist windows heads towards Germany as another group crosses in the distance.The yellow fin band dates this picture to post-August 1944.

Not arriving in the ETO until November 1943, the 401st BG was equipped solely with the B-17G version. The group had activated in April 1943 and moved to Deenethorpe during October. DUCs were awarded for attacks on aircraft production targets on 11 January and 20 February 1944. Shortly after hostilities ceased, the group returned to the US and was deactivated at the end of August 1945. The 401st BG carried the letter 'S' within a triangle on the fins of its B-17s, plus from August 1944 a diagonal yellow band (with black edging on natural metal aircraft), also across the fin.

447th Bombardment Group

The 447th BG was formed in spring 1943 in Washington state, activating on 1 May. Combat operations – from Rattlesden – did not commence until Christmas Eve. Like many groups, the 447th BG switched from a strategic to a more tactical role in May 1944 in the run-up to D-Day and during the battles for the Low Countries. Navigator Second Lieutenant Robert E. Femoyer was posthumously awarded the Medal of Honor for navigating his bomber safely home despite mortal wounds during a mission on 2 November 1944. At war's end the group returned to the US where it was briefly reactivated (without aircraft) before its deactivation in November 1945. The B-17Gs of the 447th BG wore the letter 'K' in a square as identification. From late 1944 a blue chevron was painted on the upper right/lower left wing, but this was supplanted by parallel green fuselage bands and yellow wingtips/tail surfaces from January 1945.

A B-17G of the 447th BG turns finals for Rattlesden, autumn 1944. In September 1944, coloured cowls were introduced by the group to identify squadrons, although two – the 708th and 711th – both wore yellow.



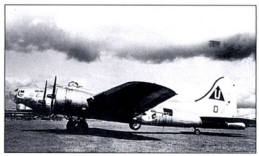
452nd Bombardment Group

Training in the US from its activation on 1 June 1943, the 452nd BG arrived in England at the end of the year, but did not begin combat (exclusively with B-17Gs) until February 1944. During its period of combat operations, the group was based at Deopham Green. On 9 November 1944, an action that resulted in the award of two posthumous Medals of Honor to members of the same 452nd BG crew took place: Lieutenants Donald Gott and William Metzger attempted to crash-land their B-17 with one operable engine in order to save a wounded gunner who was unable to bale out. All three were killed when the aircraft exploded just short of safety. A DUC was awarded to the group for an attack on the jet base at Kaltenkirchen on 7 April 1945, and five Chowhound missions were flown in aid of Dutch civilians in May. The group deactivated in the US on 28 August 1945. After January 1945, the 'square L' marking of the 452nd BG was supplemented by parallel yellow bands on the wings and across the vertical tail.

With an impressive tally on the nose, aircraft 'I' of the 730th BS, 452nd BG was photographed at RAF Digby. A '+' after the individual letter denoted this squadron.

457th Bombardment Group

Activated on 1 July 1943 at Geiger Field, Washington, the 457th BG moved to England the following January and began operations from Glatton on 21 February – during 'Big Week'. The Glatton-based group was the first to fly an all-natural metal aircraft formation and was known as the 'All Silver Group' for a time. In total, the 457th flew 237 missions with its B-17Gs, in one day short of 13 months of combat. After VE-Day, the group flew some prisoner repatriation missions from Austria before returning to the US and disestablishing in August 1945. The 'triangle U' group marking of the 457th BG was inset on a broad diagonal blue fin band from August 1944.



Helles Belle was a B-17G of the 457th BG that was forced to land at Payerne, Switzerland in July 1944. Note the fire scorching around the mid-fuselage area. The aircraft is seen at Dubendorf where flyable interned aircraft were collected.

482nd Bombardment Group (Pathfinder)

The 482nd BG was the only B-17 group to be established outside the US – at Alconbury on 20 August 1943. The group flew two squadrons of B-17s and one of B-24s, and had important radar training and operational evaluation roles in addition to its combat pathfinder duties. A DUC was awarded for an 11 January 1944 mission when the group led successful attacks on various targets in central Germany despite adverse weather and fighter attack. In February 1944 the 482nd was removed from combat and assigned the task of training pathfinder crews for other bomb groups. Nonetheless, the group carried out radar photography over occupied territory and occasionally dropped bombs on 'experimental' flights. Redesignated 482nd BG (H) in November 1944, the group was sent home after VE-Day and was deactivated on 1 September 1945. No specific group markings were carried by 482nd BG B-17Fs and Gs, although a couple of aircraft wore the 1st AD triangle.

486th Bombardment Group

The 486th BG began operations as a B-24 group, but converted to the B-17G and began operations with the Fortress on 1 August 1944. Based at Sudbury, the 486th flew 142 missions with the B-17, including suppressing defences before the Arnhem landings and supporting Allied troops during the Ardennes offensive. The group flew its last mission on 21 April 1945 and returned to the US, where it was disestablished on 7 November. The 486th BG was identified by the letter 'W' in a square. Towards the end of 1944, a red/blue chevron was added to the right upper/left lower wing, the red band outwards. From late January 1945 the wingtips and all tail surfaces were painted yellow and three yellow bands were painted around the rear fuselage.

A B-17G of the 486th BG touches down at Sudbury sometime after January 1945. The adoption of fuselage bands by some groups, notably within the 4th Combat Bomb Wing, forced the replacement of squadron code letters by coloured nose bands and prop hubs.

Left: **Miss Bea Hav To,** *a 487th BG aircraft, warms up at its Lavenham hardstand in early 1945. Cowl flaps were opened on the ground to prevent engine overheating.*

Above: Each of the squadrons of the 99th BG was identified by a Roman numeral on the fin; 'II' denoted the 347th BS.

487th Bombardment Group

Another group that formed initially with B-24s, the 487th BG converted to late-model B-17Gs at Lavenham and began combat operations with them on 1 August 1944. On Christmas Eve 1944, the largest 8th Air Force mission took place. Brigadier General Frederick Castle was leading the 3rd Air Division in a 487th BG B-17 when it was shot down by fighters. General Castle stayed with the aircraft in order to let the crew escape, but was killed when it went into a spin. He was posthumously awarded the Medal of Honor, the last and highest-ranking 8th AF recipient. In July 1945 the group returned to the US and was re-established at Drew Field, Florida, before disbanding in November. With the symbol 'square P', the 487th BG's Fortresses were further identified from late 1944 by a red and yellow chevron on the starboard wing (red band outboard) and all-yellow wingtips and tail surfaces (excluding elevators).

490th Bombardment Group

On 27 August 1944, the 490th BG completed its re-equipment from B-24s and began combat with B-17Gs, with which it flew 118 combat missions and five Chowhound food drops to Holland. Based at Eye until July 1945, the group's last assignment before returning to the US was transporting French, Spanish and Belgian POWs from Austria to transit camps. The group left the UK in July 1945 and disestablished in Florida in November. The 490th BG had no group letter symbol but was distinguished by a red top to the fin of its B-17s and red chord-wise bands on wings and tailplanes.

493rd Bombardment Group

Constituted as a B-24 group but only using the Liberator for seven weeks, the 493rd BG converted to B-17Gs and began operations with them on 8 September 1944. The 493rd was known as 'Helton's Hellcats' after Colonel Elbert Helton, the CO from November 1943 to February 1945. The group was based at Debach except during March 1945, when the air component detached to Little Walden. The group flew 110 missions with B-17s and six food-drop missions, losing 41 aircraft in combat and 31 to other causes. It was inactivated at the end of August at Sioux Falls. The 493rd BG wore red tailplane bands and a red band along the bottom third of the fin.

African/ Mediterranean Theatre

9th, 12th And 15th Air Forces

97th Bombardment Group

'Venit Hora' (The Hour Has Come)

The 97th BG was initially assigned to the 8th Air Force and flew that organisation's first heavy bomber mission on 17 August 1942 from Grafton Underwood. The 97th was the only 8th AF group to be equipped with B-17Es, but was reassigned to the 12th AF and left for North Africa in November 1942. The group mostly supported ground forces in Africa before contributing to the invasions of Sicily and southern Italy in mid-1943. As part of the 15th Air Force in Italy from November, the group conducted strategic missions in southern and southeastern Europe; for one of these (to Ploesti on 23 June 1944), Second

This B-17G is from the 414th BS of the 97th BG, as evidenced by the '4' in a circle on the fin. The 340th, 341st and 342nd squadrons were similarly numbered 1-3. In place of the ball turret is a 'Mickey' H2S radome.

Lieutenant David Kingsley was awarded a posthumous Medal of Honor for giving his parachute to his injured tail gunner, allowing him to escape their crashing B-17. Awarded two DUCs, the 97th BG was disbanded in Italy at the end of October 1945.

The 97th BG's time with the 8th AF predated the application of distinctive group markings. In the 12th AF, the 97th's geometric symbol was an outline triangle and this was carried over to the 15th AF where the 'Y' letter denoting the 5th Bomb Wing was added to the triangle (now solid). This symbol was carried on the fin and tailplanes of the B-17 and some group aircraft also sported black (or red) and white diagonally-striped rudders.

99th Bombardment Group

'Sight With Might'

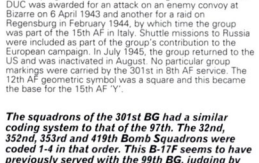
After training in the US from June 1942, the 99th BG moved to North Africa between February and May the following year. As part of the 12th AF, the 99th prepared the way for the Allied assaults on the Italian peninsula, winning a DUC for an attack on Gerbini airfield. The group moved to Italy, based initially at Tortorella near Foggia, and attacked strategic targets including aircraft factories such as the Me 109 plant at Weiner Neustadt, for which a second DUC was won in April 1944. The 99th was deactivated in Italy in November 1945. The diamond insignia of the 99th BG was – when the unit served with the 12th AF – modified with the Y of the 15th AF when that organisation came into being in November 1944. Some natural metal B-17s of the group were seen with parallel black bands on the tail surfaces.

301st Bombardment Group

'Who Fears?'

Another group that began operations with the 8th AF before moving to North Africa, the 301st was formed in February 1942 and arrived in England in August. The group flew only eight missions before moving to North Africa. A DUC was awarded for an attack on an enemy convoy at Bizarre on 6 April 1943 and another for a raid on Regensburg in February 1944, by which time the group was part of the 15th AF in Italy. Shuttle missions to Russia were included as part of the group's contribution to the European campaign. In July 1945, the group returned to the US and was inactivated in August. No particular group markings were carried by the 301st in 8th AF service. The 12th AF geometric symbol was a square and this became the base for the 15th AF 'Y'.

The squadrons of the 301st BG had a similar coding system to that of the 97th. The 32nd, 352nd, 353rd and 419th Bomb Squadrons were coded 1-4 in that order. This B-17F seems to have previously served with the 99th BG, judging by the diamond points visible behind the tail square symbol.



***Above:** Joker of the 463rd BG wears its name on its fin, an unusual but not unique presentation. The Cheyenne tail turret appears to have been retrofitted in-theatre.*

Above: B-17Gs of the 483rd BG load personnel at an airfield in Slovakia after the end of the war.

463rd Bombardment Group

After activation on 1 August 1943 and a period of training in the US, the 463rd BG moved to Italy and began combat in April 1944 as part of the 5th Bombardment Wing. Based at Celone, near Foggia, Italy, the 463rd BG won its first DUC within a fortnight of its debut for an attack on factories near Budapest; it won another for the first 15th AF mission to Ploesti, 18 May, when it was the only B-17 group to reach the target due to adverse weather. At war's end, the group flew supply missions to POW camps in Austria, then returned to the US for disbandment at the end of August 1945. The 463rd BG's B-17s used a 'pie-slice' device as a setting for the 5th Wing's 'Y' symbol. Rudders and elevators were painted yellow in the summer of 1944.

483rd Bombardment Group

The 483rd BG was established on 20 September 1943 and became operational at Tortorella on 12 April 1944. The group moved to its permanent base at Sterparone on 22 April. On 18 July 1944 the group pressed on through poor weather that had turned back all other groups on a raid on Memmingen. Attacked by 200 fighters, the 483rd lost 14 aircraft but struck the target hard, and was awarded a DUC. On 24 March 1945, another DUC was awarded for a Berlin mission during which the 483rd led 15th AF forces through heavy attack by Me 262 jets. After hostilities ceased, the group transported personnel to North Africa and was disestablished in Italy on 25 September 1945. The 'Y' marking of the 483rd BG was applied over a star and was worn on the fins and across the stabilisers and elevators of group aircraft.

Zone of the Interior

(1st, 2nd, 3rd and 4th Air Forces)

The following groups served exclusively in the United States on training or home defence duties and coastal patrol during the war.

1st Photo Group, 1st Search Attack Group,
2nd Reconnaissance Group.
Bombardment Groups: 39, 88, 304, 331, 333, 346, 383, 393, 395, 396, 444, 469, 488, 504, 505.

Below: A B-17F-70-BO wearing the badge of the 318th BS, a training unit, part of the 88th BG, 2nd (later) 3rd AF. Generally, squadron badges were not worn during the war, but were sometimes found in training units.

The markings applied to aircraft assigned to training groups varied greatly, although 'billboard' numbers were commonly used to aid formation training.

Canal Zone

6th Air Force

The Caribbean Air Force was formed as the Panama Air Force in 1940 and was redesignated the 6th AF in February 1942. The 6th, 9th and 40th Bomb Groups flew B-17s on anti-submarine patrol and Panama Canal defence missions until late 1943.

A B-17E in sea search camouflage of olive drab and oyster white flies over the Panamanian jungle.

US Navy

The US Navy operated more than 50 B-17Gs under the designation PB-1 between 1946 and 1955. Most of these were PB-1W early warning variants, fitted with APS-20 radar. They served with VPB-101 (which became VX-4), VW-1, VW-2, VPW-1, VP-51 and VC-11.

Above: A PB-1W of VW-2 is seen in the mid-1950s. The 'XD' tailcode of VX-4 was retained when that unit was renamed and given the Atlantic Coast early-warning role.

Above: VW-1 was the Pacific early warning unit, based at NAS Barbers Point, Hawaii. The 'TE' tailcode of VW-1 is seen on this retired PB-1W, circa 1955.

US Coast Guard

The USCG acquired B-17 aircraft under the designation PB-1G in 1946 and used them until 1958 on SAR, ice patrol and photographic mapping tasks from various Coast Guard Air Stations. Some of the aircraft had previously served with the Navy and others (PB-1R) were borrowed from the USAF. Most were fitted to carry air-droppable life rafts.

PB-1G 77255 was assigned to the USCG between 1946 and 1958, on SAR and ice patrol duties. This Fortress is flying today as* Yankee Lady *with the Yankee Air Force.

Foreign Users

Royal Air Force

No. 59 Squadron

'Ab uno disce omnes' (From one learn all)

No. 59 Sqn had only a brief period on Fortresses (Mk IIs and IIAs) after it converted from Liberator IIIs at Thorney Island in January 1943. The following month the squadron moved to Chivenor and flew patrols in the Western Approaches, sinking one U-boat with the B-17. Two aircraft were lost in combats with Fw 200 Condors. The squadron re-equipped with Liberator Mk Vs in March 1943.

No. 90 Squadron

'Celer' (Swift)

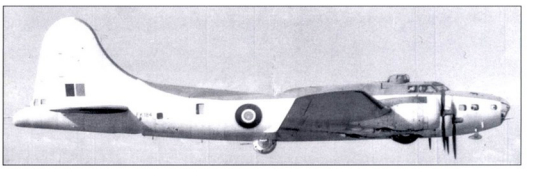
No. 90 Squadron RAF was the first unit to take the B-17 into combat, equipping with Fortress Mk Is in May 1941 and attacking Wilhelmshaven with them on 8 July. The squadron's period of high-altitude bombing was a failure, with only 51 sorties carried out (of which 27 were abortive) before the squadron gave its aircraft to Coastal Command. A detachment of four aircraft in the Middle East had little more success and the two survivors briefly became a part of a No. 220 Sqn detachment before being sent to India in May 1942. The squadron had disbanded on 12 February at Polebrook, having also flown from Watton, West Raynham and Lossiemouth while on Fortress operations. During European bomber operations, No. 90 Squadron wore the codes 'WP'.

No. 90 Squadron's time with the B-17 was not a particularly happy one. A unique variation on standard Bomber Command colours was worn by the unit's aircraft, with azure blue undersides and tail fin.

No. 206 Squadron

'Nihil nos effugit' (Nought escapes us)

Converting from Hudsons at Benbecula in the Hebrides in August 1942, No. 206 Squadron made about 17 attacks on U-boats (with one confirmed kill) before moving with its Fortress Mk II/IIAs to Lagens in the Azores in October 1943. No more kills were confirmed here but the squadron's patrols kept the U-boats off the surface, making them less effective. In March 1944 the squadron returned to the UK and converted to Liberators. Some squadron aircraft carried a code consisting of '1' and the aircraft letter.



Fortress Mk II FK184 was with No. 206 Sqn at Benbecula when seen here on 15 August 1942. Coastal Command crews much preferred the Liberator for long overwater patrols when contact with the enemy was possible.

No. 214 (Special Duties) Squadron

'Ultor in Umbris' (Avenging in the Shadows)

Reformed at Sculthorpe in January 1944 with Fortress IIs and IIIs, No. 214 (SD) Squadron became part of No. 100 Group flying jamming missions against German night-fighter and ground-based radars, as well as V-2 rocket guidance transmissions (until it was discovered that they were unguided). One of the squadron's major functions was creating spoof raids by simulating larger formations of bombers. Disbanded on 27 July 1945 at Oulton, the squadron's 'numberplate' was then given to No. 614 Sqn in the Middle East. The Squadron's Fortresses wore the code 'BU'.

No. 100 Group Fortresses were kept hangared and were not often photographed in daylight. Fortress Mk III 'W' of No. 214 Squadron is seen on a test flight. The camouflage scheme was basically the same as other Bomber Command night bombers, consisting of dark earth and dark green over gloss black.

No. 521 Squadron

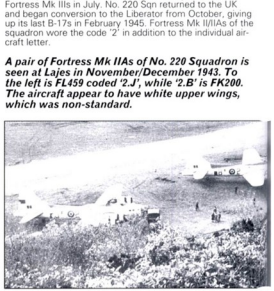
In August 1944, Fortress Mk IIs joined the mix of types operated by No. 521 Squadron at Langham (which ranged from Gladiators to Venturas) on weather reconnaissance in the North Sea area. In May 1945, some Mk IIIs arrived and both marks served with the squadron until it disbanded at Chivenor in April 1946. The squadron code was '5O' although it may not have been worn by B-17s.

No. 220 Squadron

'Kathoramen aichtoi' (We observe unseen)

No. 220 Squadron began its association with the Fortress when the detachment of No. 90 Sqn aircraft in Egypt was renumbered and handed over to Coastal Command. At the same time, the original No. 220 Sqn, based at Nutts Corner, re-equipped from Hudsons to Fortress Mk Is, the Middle East aircraft joining them in January 1942. In July, Fortress Mk IIs arrived. Anti-submarine operations were flown from a number of locations in the UK (and Iceland) until September 1943 when the squadron moved to Lajes, sinking a U-boat in mid-November. There were no more kills until September 1944, the squadron having received Fortress Mk IIIs in July. No. 220 Sqn returned to the UK and began conversion to the Liberator from October, giving up its last B-17s in February 1945. Fortress Mk II/IIAs of the squadron wore the code 'Z' in addition to the individual aircraft letter.

A pair of Fortress Mk IIAs of No. 220 Squadron is seen at Lajes in November/December 1943. To the left is FL459 coded 'Z-J', while 'Z-B' is FK200. The aircraft appear to have white upper wings, which was non-standard.



No. 223 (Special Duties) Squadron

'Alæ Defendunt Africam' (Wings Defend Africa)

No. 223 was formed at Oulton in August 1944 with Liberators, but only received B-17s (Fortress Mk IIIs and a single Fortress Mk II) in April 1945. The Fortresses served alongside Liberator Mk VIs on jamming duties until disbandment on 27 July 1945. The Squadron code was '6G'.

A Fortress Mk IIA of No. 251 Squadron is seen on a meteorological reconnaissance flight from Iceland in mid-1945. 251 was rare among Coastal Command B-17 operators in carrying full squadron codes.

No. 251 Squadron

'However Wind Blows'

Mainly equipped with Hudsons and Venturas on meteorological duties (weather reconnaissance), No. 251 Squadron began conversion to Fortresses (Mk IIs and IIAs) at Reykjavik in March 1945, a process that was never fully completed. The squadron, which had the code letters 'AD', disbanded in Iceland on 30 October 1945.

Even weather reconnaissance missions had an element of danger. Fortress Mk II FL455, 'Z9.A' of No. 519 Squadron crashed on a hillside not far from its base at Wick in February 1945. The wreck was burned in the spring (seen here) as it was to o inaccessible to salvage.

No. 519 Squadron

'Undaunted by Weather'

No. 519 Squadron was based at Wick with a variety of aircraft when it began to receive Fortress IIs in November 1944. The Fortresses flew long-range weather patrols over the North Atlantic, North Sea and towards the Arctic Sea until September 1945, when they were replaced by Halifax IIIs. Squadron Fortresses wore the code 'Z9'.

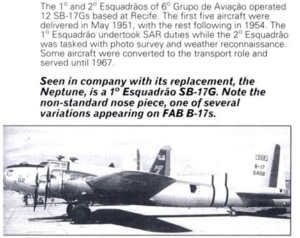
Other RAF Fortress units

No. 1 Operational Training Unit (March-October 1943)
No. 1674 Heavy Conversion Unit (October 1943-1945)
No. 1699 (Fortress Training) Flight (April 1944-June 1945)
Aeroplane and Armament Experimental Establishment
Royal Aircraft Establishment
Coastal Command Development Unit

Brazil

The 1° and 2° Esquadrãos of 6° Grupo de Aviação operated 12 SB-17Gs based at Recife. The first five aircraft were delivered in May 1951, with the rest following in 1954. The 1° Esquadrão undertook SAR duties while the 2° Esquadrão was tasked with photo survey and weather reconnaissance. Some aircraft were converted to the transport role and served until 1967.

Seen in company with its replacement, the Neptune, is a 1° Esquadrão SB-17G. Note the non-standard nose piece, one of several variations appearing on FAB B-17s.



The sole Royal Danish Air Force B-17, numbered 67-672, began its career as 42-32076 of the 401st BS, 91st BG. After service with three nations, the veteran B-17G returned to the USA and was restored to flying condition. It is now displayed at the USAF Museum.

Denmark

The Royal Danish Air Force operated a single B-17G under the designation Type 67 from 1948 to 1954. Given the individual number 672 and named *Store Björn*, the aircraft was an ex-91st BG aircraft (*Shoo Shoo Shoo Baby*) interned in Sweden and converted to a 14-passenger airliner. It was used extensively in Greenland on scientific support flights.

Dominican Republic

In February 1947 the Fuerza Aérea Dominica received two Vega-built B-17Gs to equip the Escuadrón de Caza-Bombardero, and possibly a third in 1948. Fully-equipped with turrets, guns and bombing equipment, these aircraft were kept in a guarded compound at Andrews Field and could only sortie with Presidential approval. They served until July 1954 with the sole airworthy example offered for sale in 1958, the other(s) having been cannibalised for spares.

Dominica's B-17Gs were among the last Flying Fortress bombers in service, together with Israel's. 2301 is shown with the badge of the Escuadron de Caza-Bombardero. The aircraft appears to be wearing USAAF-style olive drab.

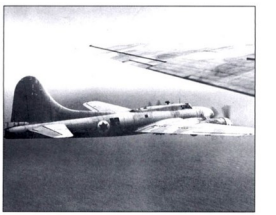
France

One B-17F (42-30177) was presented to Free French General M. P. Koening by General Eisenhower. Named *Bir Hakim* and *Charlene* at different times, the aircraft was used as an executive transport and served post-war with the French High Commisioner at Wahn, Germany.

Israel

Israel obtained three B-17Gs without armament in 1948. Another was interned in the Azores on the way to Israel. Famously, the three aircraft bombed Egyptian targets while on their delivery flight to Ekron. Moving to Ramat-David, the Fortresses formed 69 Squadron and flew over 200 missions in the War of Independence, as well as seeing action in the 1956 war. The aircraft were scrapped in Israel between 1958-62.

Below: Two of Israel's B-17s wore an appropriate desert colour scheme in the early part of their service. Top and ball turrets were added after the 1948 war and at least one received a nose radar scanner.



Portugal

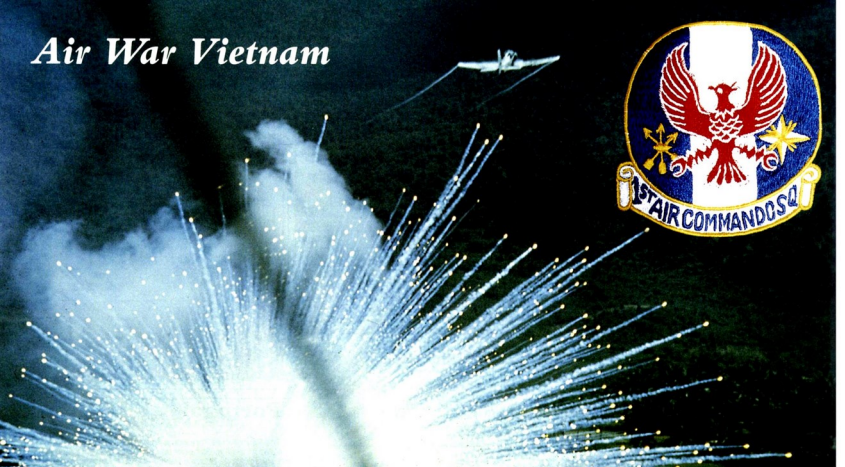
The Forca Aérea Portuguesa operated five SB-17Gs from Lajes in the Azores between 1947 and 1960 with the Esquadrilha de Busca e Salvamento on civil search and rescue duties, as well as support for the extensive NATO presence on the islands.

The Azores Islands in the Atlantic were no stranger to the B-17; RAF, Israeli and Portuguese aircraft appeared there at one time or another. Like Brazilian aircraft, the Portuguese aircraft wore a variation of the USAF/USCG SAR colour scheme.

Canada

No. 168 Squadron RCAF formed in October 1943 with a mix of aircraft, including six B-17s which were supplied from surplus USAAF stocks the following month. The aircraft were stripped of armament and armour and used for carrying mail to Canadian troops overseas. The nose section of each aircraft was modified to carry more mail and one aircraft was fitted with a further elongated wood and fabric nose. The aircraft served on the transatlantic route and throughout Europe and the Middle East until the squadron's disbandment in 1946.

The Canadian B-17s were used on the forces' mail shuttle to Europe during the war, the aircraft being modified to carry mail rather than bombs. Both camouflaged and natural metal aircraft were used.



Air Commandos

1961-1966: The Early Years

At the end of 1961 the 4400th CCTS sent a detachment of elderly combat aircraft to South Vietnam. So began the active involvement of the US Air Force in the growing war against the Communists. The Air Commando (later Special Operations) forces also grew in importance and capability throughout the conflict.

B-26K pilots of the 606th Air Commando Squadron arrive at Nakhon Phanom in early 1966. The bush hat was a trademark of the Air Commandos.

During the late 1950s and early 1960s, the fires of revolution in South Vietnam and Laos were being kindled by China and the Soviet Union. Their governments were susceptible to the classic weapons of the insurgent: subversion, propaganda, terror and guerrilla warfare. Speaking before the Party Congress in Moscow on 6 January 1961, Nikita S. Khrushchev reaffirmed Soviet determination to support 'wars of liberation' among the former colonial peoples. President John F. Kennedy took up the challenge and instructed Secretary of Defense McNamara to study ways of developing counter-insurgency forces. The US armed forces were trained and equipped to fight a major land war in mainland Europe, so had little experience of counter-insurgency. The US Army responded with its 'Green Beret' Special Forces and tasked them with establishing patrol bases along the South Vietnamese border and training locals in anti-guerrilla operations. However, they needed an efficient air supply and support organisation, and the Vietnamese army needed an experienced close air support force. The answer was not long in coming.

On 14 April 1961 the Air Force Tactical Air Command activated the 4400th Combat Crew Training Squadron at Hurlburt Field, Florida. The unit was to fly operations against guerrillas, either as an overt Air Force operation or in an undefined covert capacity. Only the best pilots were invited to join the unit, together with those who heard about the job, volunteered and then passed stringent selection tests. Known by its nickname of 'Jungle Jim', the unit was commanded by Colonel Benjamin H. King.

The squadron was authorised 16 C-47s, eight B-26s and eight T-28s, plus the same number of aircraft in temporary storage. All were old aircraft, many recently taken out of desert storage, but they were rugged and more suited to counter insurgency warfare than the regular Air Force jets. The C-47s were cargo aircraft, configured for supply drops; the B-26s were twin-engined World War II attack bombers; the T-28s were training aircraft, modified to carry 0.50-in machine-guns, 2.75-in rockets and a small quantity of bombs. All aircraft were required to operate from minimal-condition tactical airstrips, and the C-47s and T-28s from dirt runways.

On 15 August the squadron deployed Detachment 1 to Mali, West Africa. It was the first of many overseas assignments, in this case to train Mali paratroopers to jump from SC-47s. By the time they returned to Florida, a second detachment had already left for Vietnam.

Farm Gate

On 6 November 1961, the squadron was tasked by Headquarters Pacific Air Forces Operations Plan 222-61 to send a detachment to Bien Hoa Air Base in South Vietnam. Detachment 2, codenamed Farm Gate, consisted of 41 officers and 115 airmen on a 179-day temporary duty (TDY) assignment. They took with them four RB-26s, four SC-47s and eight T-28s. The B-26s carried the RB designation of the reconnaissance version, so as to not contravene the 1955 peace agreement which stated

Left: Wearing South Vietnamese markings, a B-26 flies over Bien Hoa, armed with napalm canisters.

Below: The B-26K Counter Invader was originally finished with green upper surfaces and white undersides. This example is seen in 1961 at Eglin AFB, Florida.

Left: A Farm Gate T-28 drops a phosphorus bomb on the jungle, vortices streaming from the wingtips as it pulls out of a shallow dive. Such attack profiles were very accurate, but could expose the aircraft to intense ground fire.

that bomber aircraft should not be introduced to the area. However, they were not all the glass-nosed reconnaissance version; some carried eight 0.50-in machine-guns in the nose.

The 'official' Farm Gate mission statement was that the aircraft, wearing South Vietnamese air force markings, would be used to train local pilots. In fact, they were there to fight. By November 1961 the first US helicopter units had arrived in Vietnam, to improve the mobility of the Army of the Republic of Vietnam (ARVN). American advisers were trying hard to motivate the poorly paid ARVN infantrymen. Air power was needed, to give the soldiers of the South an edge over the well-organised, highly motivated Communist guerrillas who struck without warning and vanished just as quickly.

The Farm Gate pilots were soon flying their T-28s and B-26s in combat, with a statutory Vietnamese observer in the back seat. Their presence soon reduced the number of Viet Cong attacks on trains and truck convoys. In addition, they were used to escort flights of helicopters to landing zones, where they remained on call in case of resistance on the ground. The lack of English-speaking Vietnamese observers limited the aircraft's usefulness for some time. Without clearance to engage targets on the ground, or clear communication with a South Vietnamese Army unit asking for close air support, they often had to return to base with their ordnance still on board. This happened so often that the pylon adapters suffered structural damage due to landing with unexpended ordnance.

Almost without exception, the T-28s' targets were either small boats (sampans), wood structures or personnel. Due to the hit-and-run, highly mobile tactics of the Viet Cong, these targets were seldom found in large concentrations. Enemy troop concentrations were rarely more than one or two companies and the structures no more than 10 to 15 small huts; these were ideal-sized targets for a flight of two T-28s. Occasionally, four or more aircraft would be used against a small enemy supply or ammunition concentration, with the size and nature of the target determining the number of aircraft required.

The Farm Gate pilots discovered by experience that two 500-lb (227-kg) napalm tanks were extremely effective against wooden structures or concealed or dug-in troops, while 120-lb (55-kg) fragmentation bomb clusters are very good against scattered troops. The rockets, with their high degree of accuracy, were better utilised against spot targets such as sampans,

A T-28 demonstrates the destructive power of napalm. The weapon was widely used against troop concentrations and against wooden structures.

while the 0.50-in machine-guns combined with the aircraft's manoeuvrability were better employed against highly mobile ground targets.

On 11 February 1962, the first Farm Gate aircraft was lost in Vietnam. An SC-47 with nine crew and Army advisers on board left Saigon on a leaflet-dropping mission. At 08.30 a Province Chief reported that a twin-engined aircraft had crashed in the mountains near his village, 70 miles (113 km) northeast of Saigon. There were no survivors. The crew comprised Captain Edward K. Kissam Jr, First Lieutenants Stanley G. Harrison and Jack D. LeTourneau, Technical Sergeant Floyd M. Frazier and Airman First Class Robert L. Westfall.

Ground fire threat

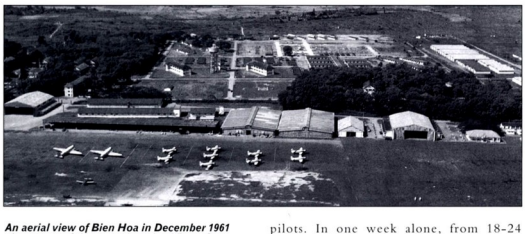
As the months wore on the Viet Cong countermeasures against the T-28 and B-26 low-level attacks began to take effect. Their main anti-aircraft weapons at that time were small arms and the 12.7-mm Soviet or Chinese heavy machine-gun. In the last four months of 1962, the enemy scored 89 hits against Farm Gate and other USAF aircraft, but in the first four months of 1963 that figure had jumped to 257. Before the end of the year the Air Force had lost six aircraft to enemy action.

In March 1962, Headquarters TAC activated the 4400th Combat Crew Training Group at Hurlburt Field. It was renamed soon afterwards as the 1st Air Commando Group in honour of a group of the same name that had been formed in 1944 to support British General Orde Wingate's Chindit troops behind the Japanese lines in Burma. Colonel Chester A. Jack was chosen to lead the group, which comprised the 6th Fighter Squadron, Commando; the 319th Troop Carrier Squadron, Commando; and the 1st Air Material Squadron, Commando. The original 4400th CCTS was renamed the 4410th CCTS and also attached to the new group.

The mission of the 1st Air Commando Group was described by Air Force Chief of Staff General Curtis E. LeMay thus: "Members of the new Air Commando Group are trained to instruct allied aircrews in all phases of airborne operations, including low-level drop techniques for both personnel and cargo, close air support – in daylight or dark – for counter-guerrilla forces, rapid deployment to areas of suspected or actual guerrilla activity, the use of flares for night-time detection of guerrilla movements and for reconnaissance, the cutting off of retreat routes by use of anti-personnel weapons, the staking out from the air of areas of suspected enemy activity, interdiction raids, destruction of supply points, and the use of psychological operations such as harassment of counter-information programmes."

On 28 August 1962, the first Farm Gate T-28 casualty occurred when Captain Robert L. Simpson was shot down while attacking a Viet Cong position in a mangrove swamp. The first U-10 Helio Courier casualties occurred on 15 October when Captain Herbert Willoughby Booth Jr and Technical Sergeant Richard L. Foxx were killed in action. Less than one month passed before Captain Robert D. Bennett and First Lieutenant William B. Tully were killed on 5 November in a B-26 crash.

A typical joint arms operation took place on 9 November when a concentration of Viet Cong was discovered on a strip of marsh near



An aerial view of Bien Hoa in December 1961 shows two of the recently arrived Farm Gate C-47s and a solitary T-28. The nine A-1s were Vietnamese Air Force aircraft.

the coast, about 50 miles (80 km) south of Bien Hoa. Vietnamese gunboats blocked the river to the north while helicopters escorted by Farm Gate T-28s moved ground troops into the area. A U-10 flown by Lieutenant Albert A. Wright, with a VNAF forward air controller on board, orbited the area while the ARVN began shelling the enemy. A C-47 flown by Captain William F. Brown arrived around 20.00 and dropped flares at the direction of the FAC, while RB-26s dropped their ordnance on the Viet Cong concentration. The ARVN spent the next two days mopping up and although, as usual, exact casualty figures were not known, the operation was claimed to be a success.

Defence of the outposts

Support of isolated forts and outposts became a key role for the air commandos in these early days. In one such instance on 16 November, Captain Dalton and his navigator Lieutenant Charles Kuczaj were scrambled in their B-26 at 23.25 and arrived over a besieged ARVN fort near Tra Vinh around midnight. A VNAF flare ship cleared them to drop ordnance to within 200 m (655 ft) of the fort, and they attacked the VC with napalm, 120-lb (55-kg) fragmentation bombs and 0.50-in machine-gun fire. As the enemy withdrew along a river, Dalton continued his attack with 100-lb (45-kg) general-purpose bombs and machine-gun fire. The night belonged to the Viet Cong, and many such outposts would have been overrun were it not for the skill and bravery of the Farm Gate pilots. In one week alone, from 18-24 November, Farm Gate crews flew 70 combat support missions, air-dropped 9,000 lb (4080 kg) of cargo and air landed another 7,000 lb (3175 kg).

Lieutenant Colonel Philip O'Dwyer and Major Robert P. Guertz carried out an attack on 23 November on a large building south of Can Tho and then raked the bordering canal, which was obscured by overhanging trees. Friendly ground forces found that the area had been an arms factory, with sampans using the canal to transport raw materials in and finished arms out. The crew was credited with 281 enemy casualties, 20 motorised sampans, six smaller boats and a wrecked arms factory.

On the negative side of the account, problems were being encountered with the 0.50-in ammunition that had been manufactured in 1945. The ammo crates were rotten, the cans inside were rusted, rusty links caused the belts to fall apart when removed from the cans, ammunition caps were pushed in by the firing pins, and swollen rounds were common. Similar problems were encountered by some types of bombs. The problems remained until newer ordnance arrived.

By the end of 1962, the Farm Gate crews had flown 4,040 sorties in support of the government of South Vietnam, over 1,000 as escort duty for trains, convoys and aircraft. During the year, over half a million items of ordnance were used by the crews, who were credited with 3,381 enemy casualties, 4,151 structures and 405 sampans damaged and destroyed. However, as the enemy grew more aggressive and confident, it developed its own tactics to counter air attack. In the meantime, events in 1963 proved that the air commandos were to suffer more casualties due to their own defective aircraft than to enemy fire.

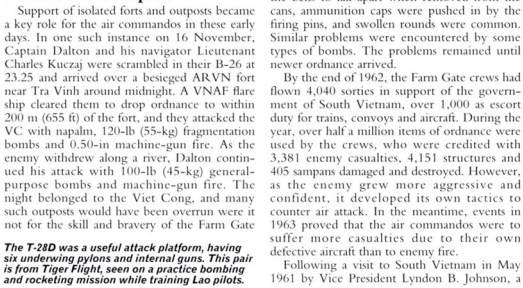
Following a visit to South Vietnam in May 1961 by Vice President Lyndon B. Johnson, a joint American/South Vietnamese Combat Development and Test Centre was established, to learn and improve counter-insurgency techniques and tactics. One of the first ideas put forward by the new centre involved the use of aerial-delivered defoliants to reduce jungle cover along major highways, where the Viet Cong frequently ambushed government convoys. The idea grew within months into Operation Ranch Hand; the first Fairchild C-123 Provider transport aircraft fitted with the MC-1 Hourglass spray system arrived at Tan Son Nhut air base on 7 January 1962, and operations commenced a week later. (This was 30 months before the infamous Gulf of Tonkin Incident that brought America into the war and over three years before the arrival of the first American combat troops.) The unit was known as the Special Aerial Spray Flight and was later attached to the 309th Air Commando Squadron. In October 1966 an expansion of the Ranch Hand programme led to the establishment of the flight as a separate squadron, the 12th Air Commando Squadron.

The herbicide selected for initial use was 24D/245T, proven weed-control chemicals widely used throughout the world and readily available from chemical manufacturers. The most widely used herbicide sprayed by Ranch Hand aircraft was the herbicide Orange. The name was derived from the coloured bands painted on the 55-US gal (208-litre) drums, which allowed longshoremen and logistics personnel to identify the different liquid products.

Agent Orange

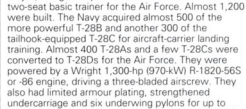
Herbicide Orange killed weeds, brush and other foliage of the broadleaf variety. The major element of the herbicide is Dioxin, now believed by many to cause birth defects in children fathered by men who have had contact with the chemical. Over the years the programme expanded and by the time it was halted in 1971, following concern about the chemicals' side-effects on humans, 41 per cent of the mangrove forests in South Vietnam had been affected, together with 19 per cent of the

The T-28D was a useful attack platform, having six underwing pylons and internal guns. This pair is from Tiger Flight, seen on a practice bombing and rocketing mission while training Lao pilots.



North American T-28 Trojan

Farm Gate's main ground attack aircraft was the T-28 Trojan, designed by North American as a tandem two-seat basic trainer for the Air Force. Almost 1,200 were built. The Navy acquired almost 500 of the more powerful T-28B and another 300 of the tailhook-equipped T-28C for aircraft-carrier landing training. Almost 400 T-28As and a few T-28Cs were converted to T-28Ds for the Air Force. They were powered by a Wright 1,300-hp (970-kW) R-1820-56S or -86 engine, driving a three-bladed airscrew. They also had limited armour plating, strengthened undercarriage and six underwing pylons for up to 4,000 lb (1815 kg) of ordnance. The T-28D-5 model had in-wing ammunition storage and separate wing stations for a pair of 0.50-in gun pods. Apart from the gun pods, the ordnance stations could also carry napalm, general-purpose and fragmentation bombs, rocket launchers and parachute flares.



The Ranch Hand mission was initially undertaken by the UC-123Bs of the 309th ACS Special Aerial Spray Flight (above). The Providers usually flew in groups (right) to cover a wide swathe with defoliant.

uplands forests and 8 per cent of all cultivated land. Eleven million of the 19 million US gal (41 million of 72 million litres) of chemicals used were of the type known as Agent Orange. Thousands of Vietnam veterans subsequently filed disability claims against the US government, alleging damage to their health caused by the herbicide.

Political, legal, moral and ecological aspects notwithstanding, the defoliation programme seemed a good idea at the time and the first flight took place on 13 January 1962. On 2 February 1962 one of the Ranch Hand C-123s became the first Air Force aircraft to be lost over South Vietnam when it crashed, killing the crew of three: Captain Fergus C. Groves, Captain Robert D. Larson and Staff Sergeant Milo B. Coghill. Although the cause of the crash was never determined, from then the Thirteenth Air Force requested escorts by Farm Gate aircraft for all future defoliation missions.

Being hit by enemy ground fire became almost routine for Ranch Hand aircraft while flying at 150 mph (240 km/h) and 150 ft (45 m) above the crops and jungles of Vietnam. Ranch Hand aircraft sustained well over 5,000 hits by enemy fire during a 10-year period. The most celebrated Ranch Hand aircraft was nicknamed ***Patches*** after being hit by more than 800 rounds of enemy fire and is now on display at the Air Force Museum at Wright-Patterson AFB, Ohio. Twenty-five Americans lost their lives flying the defoliation mission in Vietnam.

Charlie Harper was with the second group of Farm Gate pilots to arrive at Bien Hoa in February 1962, and flew the B-26 with Robert Davis. "I went to the Special Forces jump school and was jumping with the Vietnamese Rangers when I got a bad chute. I was the last one out and the first one down and broke my back. I spent six weeks lying around until our flight surgeon Doc Baker told me that if I could get into a B-26 I was qualified to fly again.

"My last mission was the most memorable. A C-123 had gone down and we were searching the mountain area southeast of Ban Me Thuot when we lost the number 2 engine. The bird would not maintain altitude, so we dumped all ordnance, but still continued to sink. We broadcast a Mayday and headed for the little Ban Me Thuot airport. While on short finals we dumped the canopy and lowered the gear, creating more drag, and got to the ground just before the wheels locked down. They had to hang two new engines and props to fly it back to Saigon and we were grounded to meet a flying evaluation board. The board said that if we had acted correctly, the wheels would have been down prior to landing. However, when they checked out the hydraulic system they found that the filter screen which catches any impurities had been ruptured sometime between 1960 and 1962 and it took the wheels almost twice as long as usual to extend and lock. We were then given a clean bill of health."

The defoliation mission was later flown using the jet-augmented UC-123K, from mid-1967 onwards. This improved load-carrying and decreased vulnerability.

The Hourglass spray gear of the UC-123B was arranged along the wing trailing edges and in the rear loading ramp to ensure coverage across the whole span of the aircraft.

Above: A Ranch Hand Provider taxis for a defoliation mission in front of standard transport aircraft at its base at Tan Son Nhut. In common with many Air Commando aircraft, it wears VNAF insignia, although flown by Americans.

Don Schoknecht was a B-26 maintenance engineer assigned to Farm Gate, who arrived at Bien Hoa in August 1963. He recalled: "All the B-26s were 1944 models; three of them were painted black and used mostly for convoy escort, etc. They were the only B-26s with 14 0.50-in machine-guns: eight in the nose and six in the wings. Because of their configuration they only had one bomb rack on either wing, inboard of the guns. The other aircraft had three bomb racks on each wing and six 0.50's in the nose. The usual load was six 750-lb napalm canisters on the wings and in the bomb bay a mixture of general-purpose, fragmentation bombs and WP – white phosphorous bombs. The pilots liked a load of napalm and WP.

"There were only two things on a '26' that I didn't like working on and that was replacing oil coolers and installing cockpit canopies. I will never forget my first oil cooler change. The right oil cooler had to be replaced, but, as we did not have any, I was sent to Saigon to get one out of a '26' the French left there. This was the day after President Diem was overthrown and killed and we went right past the bullet-riddled palace.

"I had one canopy change after Captain Smith landed at night and in the rain without flaps, due to a broken cable. They went into the grass and mud between the runway and taxiway and jettisoned the canopies. Another incident was when a '26' hit a tree: the left bottom cowling was all torn up and wood was so hard-packed in the cooling fins we couldn't get it out with a hammer and chisel!

"'Jumping Joe' Kittinger was one of our pilots; I remember his last mission, when he came in over the flight line and rolled his '26'!"

The pilots of Farm Gate had been given old aircraft with which to work, and eventually both the T-28s and B-26s started to crash due to structural defects. In February 1963 two Farm Gate B-26 aircraft were destroyed within days of each other. On 3 February, Captain John P. Bartley and Captain John F. Shaughnesy, Jr were killed during a strafing run on a VC concentration 33 miles (53 km) west of Soc Trang. Three days later Major James E. O'Neill's aircraft lost both engines while on a training flight at 500 ft (150 m). He ordered the other two crew members, an American navigator and a VNAF observer, to bail out. Major O'Neill held the aircraft steady while they bailed out, but the aircraft crashed before he could get out himself. The lack of a good ejection system was a hazard on these old types of aircraft, and the B-26 was notoriously difficult to bail out of when flying straight, let alone while banking or in a dive. One had to blow the canopy, climb out of the cockpit and then dive off the trailing edge of the wing, taking care not to hit the propeller or the horizontal stabiliser.

On 8 April, Captain Andrew C. Mitchell, III, pilot, and Captain Jerry A. Campaigne, navigator, plus a VNAF observer, were killed when their B-26 crashed on a mountain during a two-aircraft interdiction mission. Those who observed the incident reported that part of a wing broke off during a strafing run.

In the opinion of some pilots, the B-26s should have been withdrawn from Vietnam much sooner than they were. The aircraft were grounded only after the crash of a B-26 at Eglin Fields Range 52 on 11 February 1964, during a night demonstration for an invited audience, including 19 journalists. In April 1964 the surviving B-26s finally left Vietnam and returned to the US. The T-28s were not far behind, going to the Waterpump detachment in Thailand. The Farm Gate detachment became the 1st Air Commando Squadron and started to re-equip with the Douglas A-1 Skyraider.

Crash landing

First Lieutenant Tom Schornak was among 80 air commandos who flew into Vietnam for the June 1963 rotation. Almost all of them were on some form of flying status. Six months later, 13 of that group had been killed; only Schornak managed to survive his T-28 crash and make it out alive. On 10 September 1963, Schornak and his wingman Frank Gorski were sent south, to the tip of the Mekong Delta near Ca Mau, to attack a Viet Cong force. While making his second bombing run to drop a canister of napalm, the aircraft was hit by ground fire.

"On the way in for a second pass I saw people shooting at me from the banks of the canal. It was surreal. Here I was on a nice sunny day, just flying along, and these guys were lined

Left: To ensure good coverage, the Ranch Hand aircraft had to fly very low, making the job rather hazardous. Close support escorts were regularly provided for the lumbering Providers to suppress any ground fire that may have been encountered.

Below: Six UC-123Bs of the 12th Air Commando Squadron taxi for a mission from Bien Hoa. Defoliation flights were often targeted along the sides of rivers or roads to deny the Viet Cong any available cover for ambushes.

up along the canal pumping shots at me. Some of them were so damn close I could see the men's shoulders recoil from the firing of the guns. I thought to myself, 'Now I know how a Canada Goose feels making an approach to a North Dakota grain field when the Ducks Unlimited guys open up on him.'

"I made the release and the can of napalm lit off. It isn't necessary to look around to confirm when a can goes off; a concussion wave hits the aircraft and lets you know it exploded. At night it is even more exciting because it not only gives you a kick in the pants, but lights up everything for a mile or so all around you.

"On my very low-level jinking away from the target I noticed a faint, sweet, acrid smell. It was then that Frank made his attention-getting call. 'Lead! You're on fire! Lead! You're burning!' A glance inside the cockpit confirmed the worst. Very hot engine oil was gushing out of the right air ventilation duct, obscuring the instrument panel. Red warning lights began to glow through the oil, advising me things were not going well.

"My main concern was to depart the area where I had been dropping cans of napalm on people. They don't take many prisoners and would like nothing more than to have me belly in next to them. My next concern was to get some altitude with the failing engine. There were no ejection seats in the T-28; it was over the side like in World War II movies. I had always set 1,000 ft for the minimum to try to jump out, but now I was less than 700 ft, so that option did not exist. I tried to climb, but it was useless; the increased power really sprayed that very hot oil around the cockpit. To compound my problems, the temperature of the oil and the chemicals in it were burning my eyes; it was all I could do to keep them open.

"As the engine lost more and more oil, it began to surge violently, seemingly vibrating

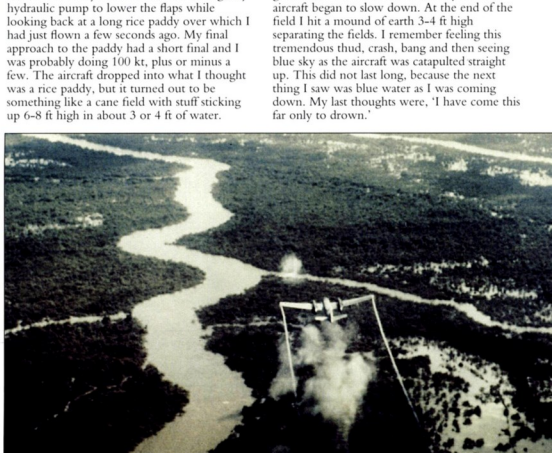
A B-26 makes a low bombing run over the Plain of Reeds in the early days of the Farm Gate detachment. The initial four aircraft were designated RB-26 to avoid contravening previous peace agreements.

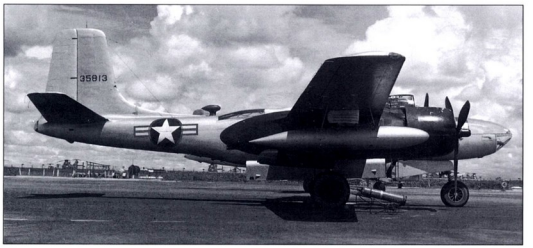
out of its mountings. It soon became obvious the old girl was about ready to give up the fight. By now all forward visibility was gone, so I opened the canopy; although it improved visibility, the turbulence made the oil spray around the cockpit even worse.

"All this was academic, because the engine gave up the ghost with a few gasps and we were on our way down. I used the emergency hydraulic pump to lower the flaps while looking back at a long rice paddy over which I had just flown a few seconds ago. My final approach to the paddy had a short final and I was probably doing 100 kt, plus or minus a few. The aircraft dropped into what I thought was a rice paddy, but it turned out to be something like a cane field with stuff sticking up 6-8 ft high in about 3 or 4 ft of water.

Above and top: Two views show B-26Cs during the early Farm Gate operations at Bien Hoa. The C model was highly effective thanks to its eight-gun nose and six underwing pylons.

"Initially, I just sunk into this growth as a blur of green paste hit the windscreen and shot past the open canopy. The T-28 hit bottom with a solid jolt and we began to slide. The good Lord was with me on this day and the aircraft began to slow down. At the end of the field I hit a mound of earth 3-4 ft high separating the fields. I remember feeling this tremendous thud, crash, bang and then seeing blue sky as the aircraft was catapulted straight up. This did not last long, because the next thing I saw was blue water as I was coming down. My last thoughts were, 'I have come this far only to drown.'





With US Army H-21s in the background, a glass-nosed RB-26B rests at Bien Hoa. The 1955 peace agreement was circumvented by the application of VNAF markings and the mandatory carriage of a Vietnamese observer. These niceties were soon discarded as the war developed.

Water came in the cockpit, and I blacked out momentarily. It could have only been a few seconds or so, because when everything cleared my left hand was on a very bent and deformed trigger for the two 0.50-in guns – that were firing under water. I mused on this, thinking how odd it was that the guns could fire under water. This did not last long before I was on my way out of the aircraft, now filling with water. Lucky for me it was only 3-4 ft deep.

"My first concern was to check the condition of the Vietnamese 'observer' riding in the back seat. These guys only rode along with us on missions, they spoke only Vietnamese, and it seemed as though you never flew with the same guy twice. So it was hard to get to know them. But he was my responsibility, and when I climbed out on the wing and looked in the rear cockpit, he wasn't there! He later told me, through an interpreter, that the ride was very, very exciting, the oil was very hot and when I opened the canopy it was his cue to jump out. This he did at 700 ft, and the chute opened just above a banana grove. He landed, discarded his air force issue flight suit, donned his black pyjamas and became one of the local boys!

"Things back at the crash site were not as straightforward. My wingman was strafing out a few hundred yards in front of me. Because of the vegetation I could not see his targets, but assumed Frank was not shooting just for the hell of it. At this time there were no fancy radios for us to switch on and talk to wingmen. To my knowledge there were no helicopters this far south and the few we had would take hours to get here, and by then it would be night and every VC and peasant in the Delta would be out on a full hunt for the downed pilot. Things were just not looking good right then.

"I took out an M2 0.30-in folding-stock carbine that had two 30-round clips taped to the stock. Then I took out my 0.45-in automatic from my shoulder holster and put the first round in the chamber. I then moved back into the heavy vegetation to await my fate.

"I was covered with oil, and as I waded through the water and growth an oil slick mirrored my every move. I knew as soon as everyone could get organised they would most likely parachute in a company of South Vietnamese Marines to even the odds. I also knew it would take some time to get all this organised and it would not happen before dawn. It would be a long night mucking around in the field evading the bad guys.

"Fortunately, my buddies were indeed working on the problem, and one of them flew over Ca Mau and saw three brand new UH-1A 'Huey' helicopters sitting on the dirt strip. They were some of the very first sent to Vietnam. It seems as though Brigadier General Stillwell was there, getting a briefing from some of his units. The Army pilots were contacted and, with no hesitation whatsoever, were on their way to get me.

"Soon I heard the unbelievable sound of the now-familiar 'whump, whump, whump' of a 'Huey', and they closed on my location. I climbed on the skids of the chopper looking like a guy full of oil who had just survived a freighter sinking. The crew chief gave me a canteen, and made me sit on the floor of the chopper because I would dirty the seats of the general's plushed-up helicopter!"

Skyraider arrives

The Farm Gate detachment was replaced by the newly formed 1st Air Commando Squadron, Composite, activated in July 1963 and assigned to the 34th Tactical Group at Bien Hoa. The new squadron initially inherited six C-47s, four U-10Bs, 13 T-28s and 13 B-26s. In March 1964 the decision was made to replace the structurally unsound T-28s and B-26s in Vietnam with 25 two-seater A-1E Skyraiders. However, this decision came too late for two Air Force pilots and their Vietnamese observers.

For interdiction missions against the Ho Chi Minh Trail, the 1st ACW began operations from the Thai base at Nakhon Phanom (above). The B-26K replaced the earlier B-26B/Cs, operating with the 606th ACS at NKP (below) and with the training unit at Eglin (left).

On 24 March 1964, one T-28 crashed after its wing sheared off during a bombing run and on 9 April a second T-28 ploughed into a rice paddy after both its wings fell off during a dive.

By the summer of 1964 the first of the Skyraiders had begun to arrive at Bien Hoa. The new Skyraider pilots adopted the callsign HOBO. Like the Farm Gate mission, the official role of the 1st ACS was to train Vietnamese pilots and fly into combat with them in the two-seat aircraft. Some months passed before the order to take along the requisite Vietnamese was rescinded.

Waterpump

Across the western border of Vietnam lay the Kingdom of Laos. Here the situation was even more complicated than in Vietnam: a civil war was taking place, combined with an attempt by the North Vietnamese to establish their Pathet Lao allies in the north of Laos while infiltrating men and supplies down the Ho Chi Minh Trail, which ran down the eastern side of the country and into South Vietnam. The trail was the means by which North Vietnamese troops could avoid the Demilitarized Zone that divided the two Vietnams. They simply walked into Laos, around the DMZ and then into the jungles of South Vietnam. The NVA troops could also violate the border Laos shared in the south with Cambodia and continue their trek southwards on the Cambodian side of the border with South Vietnam, crossing over into the Mekong Delta flatlands in the extreme south of Vietnam.

The 1962 Geneva Accords forbade foreign troops from operating in Laos. The United States obeyed the agreement, the North Vietnamese did not. American support was given covertly by the Central Intelligence Agency, using its own 'airline' of Air America. An uneasy peace continued until 16 March 1964, when the Pathet Lao, with North Vietnamese backing, attacked across the Plain of Jars. As the neutral Royal Laotian government forces began to fall back, plans were already being made to increase American air support.

On 5 March 1964 Headquarters USAF approved the deployment to Udorn Royal Thai Air Force Base of Detachment 6, 1st Air Commando Wing. The detachment, known by the nickname 'Waterpump', consisted of four T-28s and 41 men; its mission was to train Laotian and Thai pilots and maintenance personnel. Not coincidentally, this unit also provided a source of US-controlled aircraft to augment the T28s of the small Royal Laotian Air Force and came directly under the control of US Ambassador Leonard Unger in Vientiane.

In July, Lieutenant Colonel William C. 'Roadrunner' Thomas arrived to command the unit. A former World War II and Korean War pilot, the super-fit commander ran everywhere, hence his nickname. During his tour of duty, 'Waterpump' achieved with 66 men what a regular air force unit would require 350 men to accomplish: 16 C-47 pilots, 26 Thai T-28 pilots, nine Laotian T-28 pilots and a dozen Air America T-28 pilots were trained, plus various maintenance personnel.

Don Schoknecht was still serving with the 1st Air Commando Squadron at Bien Hoa around this time. "When we started receiving the A-1Es, the AT-28s were being sent to Laos and

Armed with anti-personnel bombs and machine-gun pods, this Farm Gate T-28 awaits its crew at Bien Hoa. The 1st ACS Trojans were replaced from 1964 by Skyraiders.

Thailand, so I volunteered to go there. We got all the T-28s to the Air America complex at Udorn and proceeded to strip them of their Vietnamese markings and apply Laotian markings. The first pilots I recall seeing were in civilian clothes and carried an old M-1 carbine and a Colt 45. I don't know who these people were but I think they were our guys filling in until they got the Laotians trained."

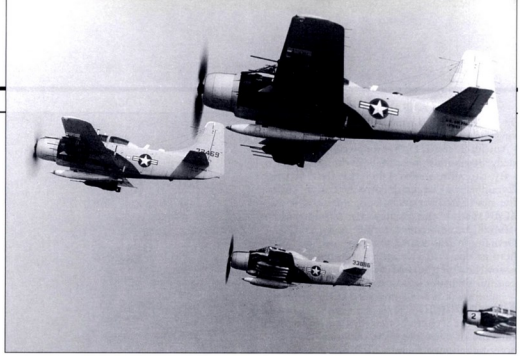
Joe Holden was sent to 'Waterpump' as an instructor. "We had three types of people to train: 'C' pilots, who were Laotian kids 18 or 19 years old who could not speak English or fly at all, although we had a few older pilots who had been trained by both the Russians and the French; 'B' pilots, who were Thai nationals flying as mercenaries for the CIA, who would go from Udorn to Vientiane and fly air support for General Vang Pao's 'secret' Hmong army in Laos; and finally we had 'A' pilots, civilian American pilots working for Air America and flying armed T-28s as escort for Air America H-34 helicopters on search and rescue missions."

Tony Durizzi was one of the Air America pilots flying the T-28. "In 1964 I flew approximately 20 missions, half search efforts and the rest road interdiction on the Laos-North Vietnam border at Ban Ban. I was also involved in six downed-pilot pick-ups in Laos. We were usually in a flight of four and I flew

Typical Air Commando attacks: in the scene below supply trucks burn on the Ho Chi Minh Trail, while at right white phosphorus bombs explode among VC positions along a river bank in the Mekong delta.

Douglas A-1E Skyraider

Douglas's E model Skyraider was a side-by-side two-seater with a large compartment behind the pilots, formerly used by the Navy to house two electronic equipment operators. The aircraft had all been overhauled before delivery but were still old by definition. Nonetheless, the Skyraider was ideal for conditions at that time: it could stay in the air for hours and carry a prodigious bomb load. The aircraft was almost 40 ft (12 m) long and had a 50-ft (15-m) wingspan. Its huge four-bladed propeller turned on an 18-cylinder Wright R-3350 engine that was the biggest and most powerful engine ever installed in a single-propeller aircraft. The Skyraider could carry up to 12,000 lb (5445 kg) of bombs, rockets or napalm and mounted four 20-mm cannon with 150 rockets each. It had a range of 1,100 nm (1850 km) and could loiter over a target for hours.



Above: Four A-1Es head out on a mission, two loaded with iron bombs configured with 'daisy-cutter' fuze-extenders and two with wall-to-wall napalm canisters. The Skyraider was also able to carry wide mixes of ordnance, making it ideal as a close support and ResCAP platform.

Right: The A-1E had seven stores pylons under each wing and another on the centreline. The two-seaters were later augmented by single-seaters when the need to carry Vietnamese observers evaporated.

the number four slot. The flight leaders were my fellow Air America pilots who were also lucky enough to get into the T-28 programme and managed to live through the many experiences we had.

"I remember one mission in particular, must have been in August 1964. We were sent on a search for a downed USAF B-57 Canberra bomber. Our flight of four got airborne from Vientiane at 10.00 and reached the scene 30 minutes later. Heavy cumulus build-ups in the area around the Plain of Jars. Dropped down to 400 ft to look and came under intense AAA fire from the surrounding road junction. We called off the search and expended our rockets and 50-calibres on the road junction, setting a few trucks on fire. Remarkably, we took almost no hits on our T-28s. Mine started running rough, so I left the formation and diverted to Lima Site 36, landed, refuelled and left for Vientiane after a good run-up of the overworked Wright R-1820. The B-57 wreckage was found that day by Hmong tribesmen. No survivors.

"Sadly, four 'Waterpump' pilots flying two T-28s were lost on one mission. They were Major Otis Gordon, and Captains Ray Eason, Gus Albrecht and Lenny Hudson. They were on a fact-finding mission regarding replacing the T-28s at 'Waterpump' with the Skyraider. Regrettably, the A-1E was never turned loose to Air America. We could have really used the heavy ordnance load and the six-hour loiter time they allowed."

'Gooney Birds'

The Farm Gate detachment and its successor, the 1st Air Commando Squadron, possessed integral airlift capability in the shape of the C-47. That type was chosen because many foreign governments used the Skytrain, so it was easier to train and operate with them and carry out covert operations if required.

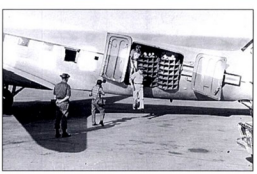
Wade Everett, III recalled one innovation that was tested by his 'Gooney Bird'. "During the spring of 1962 my crew had the distinction of being the only 'Goony Bird' crew to drop napalm in combat. It was purely experimental and worked well for the first three missions. We built a railway-type ramp running the length of the aircraft to the cargo door and carried 10 pallets, with a single roller in the middle to roll down the ramp and out of the door. Each pallet carried a 55-gal drum of napalm with an exploding cap strapped to it.

"When ordered to burn up an enemy village or area we would fly a downwind pattern as if we were going to land and increase our speed so that when we turned final we would be flying at about 170 mph. We got down to 10-15 ft above the ground, flying level. When we hit the green light the crew in the back would shove out one pallet. The pallet would generally fly harmlessly under the tail of the aircraft and the napalm would hit the ground and explode.

"One day we kicked out one pallet and I felt a tremendous jolt on the horizontal stabiliser and the yoke lurched forward in my hands. I regained control and gained height as the plane started shaking violently. It turned out that the napalm barrel had not separated properly from the pallet and it hit the tail of the plane. Fortunately, the tail stayed together and we made it home safely. The idea was abandoned after that."

Curt Messex had a surprise one night when he flew his C-47 to a Special Forces camp to practise close air support with two flights of two T-28s and two B-26s. A visual marker on the ground, made out of flaming oil pots positioned in the shape of an arrow, indicated the direction of the imaginary attack.

"I was listening to Gene chit-chatting with the Special Forces radio operator on FM when the routine came unglued. 'We're under attack! They're hitting the west side. We're turning the



Above: Four grey-painted SC-47s were included in the initial Farm Gate detachment, one being seen here in 1962.

Left: For the psywar mission the 1st ACS C-47s had loudspeakers mounted in the cargo door. This is an early speaker arrangement.

fire arrow now.' I grabbed my microphone. 'Red Flight, this is Green One. This is no drill, the camp has just come under attack from the west side. What's your position?'

"'Red Flight is overhead now. We have you in sight. Ready to go in hot.'

"'Stand by for target.' I switched to intercom. 'Load, pilot. Stand by with three flares. The fort is under attack. This is for real!'

"'Red Flight. The VC are in the open between the trees and the fort on the west side and nearly up to the walls. The fort is asking for help. Flares in 30 seconds. You're cleared in when ready.'

"I switched back to intercom and turned in right across the target: 'Flares . . . now!' Back to radio: 'Flares coming on now.'

"Red Lead responded without waiting for the first flicker of flare light. 'Red Lead in hot, bombs, flare ship in sight.'

"The three parachute flares flickered to full intensity, bathing the whole area in the eerie, unsteady white light of blazing, dripping magnesium, and Red Lead, already halfway down, reacted: 'Holy Toledo, there's hundreds of them down here!'

"'Red Two in hot, bombs, flare ship in sight.'

"The two T-28Ds tore across the target area, one after the other. Momentary red-yellow blossoms formed in the centres of dust doughnuts as bombs exploded close behind each one. Seconds later concussions bounced our aircraft. Red Lead came back on the air, snapping at his wingman, 'Red Two, turn your damned lights off! Tight patterns for the guns. Follow me around. Concentrate on the ones closest to the wall. Green, keep those flares coming. We're working low and won't be up to your altitude.'

"'Roger, Red. Do your thing. I'll warn you if we have a dud problem.'

"The other pair of T-28s checked in. 'Blue Flight overhead at five, target in sight, flare ship in sight. Ready to go in hot.'

"'Roger, Blue, keep me in sight and you're cleared in as soon as Red Flight calls off.'

"The B-26s came on the frequency, obviously close enough to see the bomb explosions. 'Green One, this is Black Flight about 10 out. I see explosions, what's going on?'

"'Roger, Black, stand by one.' I switched to interphone to order two more flares and came back to radio. 'Black, this is Green. The fort is under attack. Red Flight is working now and is about done. Blue is holding above me at five ready to go in hot. If you'all hurry we'll keep the party going.'

"'We'uns is a-hurrying, buddy. Break. Black Two, push 'em up.'

"'Red One off. Winchester. Lights on.'

"'Red Two off. Winchester. I've got you in sight, Lead.'

"Blue Lead didn't wait for an invitation. 'Blue One in hot, bombs and guns, flare ship in sight.' 'Cleared.' 'VC are retreating toward the trees now, Blue.'

"Back to interphone, 'Two flares now.' I was keeping a constant string of flares going, making sure there were at least two burning at all times with plenty of overlap. Blue Flight hammered the attackers back toward the tree line. Black Flight came overhead and watched impatiently as the swarm of miniature black figures scrambled back toward the protection of the jungle.

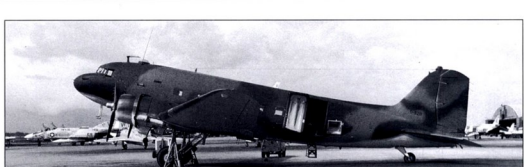
"The fort called for strikes in the edge of the trees and the B-26s went to work, tearing up the scenery with their much heavier load of bombs and guns. By the time Black Two made his last pass the target area had moved 300 yards into the trees. The fort radio operator was nearly babbling with glee. 'All the guys are standing up on the walls and cheering every time an aircraft goes by! We would have been overrun without you, there were hundreds of them coming at us!'

"A few days later we heard that the Special Forces unit had found about 200 bodies, which, if true, made the strike the most successful single air action against the Viet Cong up to that time."

In October 1964 a test team arrived at Bien Hoa to convert one of the Air Commando C-47s into a gunship. The aircraft was modified to carry three six-barrelled Minigun pods on the port side: one firing through the open cargo door and the other two through the last two windows on the port side. With each gun capable of firing 6,000 rounds per minute, tests proved that a burst could cover an area the size of a football pitch and put a round into every square foot. The new gunship could prove to be a lifesaver to besieged hamlets and forts in

Left and right: T-28s served at Udorn with the 'Tiger Flight' (Waterpump detachment of the 1st ACS), adorned with Royal Lao Air Force markings to train Laotian pilots. The camouflaged USAF aircraft were operated by the 606th ACS on interdiction sorties.

Above: Armourers load flares into a 14th ACW C-47 at Pleiku. These 80,000-candlepower flares allowed the night attacks to be undertaken before more sophisticated equipment arrived.



The 5th ACS operated the C-47 on 'Bullshit Bomber' psywar missions, the aircraft being equipped with a large loudspeaker in the door. This example is seen at Da Nang in late 1966.

the countryside. Combat testing confirmed the theory that an aircraft with side-firing guns could continuously engage a target on the ground and keep it under fire as it circled the target in a left bank.

The first AC-47 squadron, the 4th Air Commando Squadron, deployed its 20 gunships to Vietnam in November 1965. The aircraft were given the name 'Spooky' or 'Puff the Magic Dragon' by those who had witnessed their nocturnal displays of firepower.

Psywar ops

Psychological warfare was another innovation turned over to the Air Commandos. Eventually the 5th and 9th Air Commando Squadrons were formed to fly the C-47 'Bullshit Bomber' and the Cessna O-2 Skymaster on dedicated psywar missions, but in the early days the responsibility fell to the four U-10 Helio Couriers attached to the 1st Air Commando Squadron.

Earl Tighe was one of the pilots. "At first glance the U-10 looked like any other lightplane, but a second look disclosed that it had a three-bladed propeller, large leading-edge slats and large flaps. These characteristics gave the plane a short take-off and landing (STOL) capability that was necessary for operating from the small unimproved landing strips located in that part of the world. Specialised equipment installed in the four-place aircraft consisted of two loud speakers, a portable tape recorder, a 250-watt transistorised amplifier and 140 lb of armour plating. The low noise level of the single engine permitted the speakers to be heard clearly when the aircraft was as high as 2,500 ft above the terrain.

"I was in Vietnam from June 1964 through May 1965 and the majority of my U-10 missions during that time were psychological warfare operations. The routine varied, but often started with a stop at Tan Son Nhut to pick up one or two Vietnamese enlisted men who would operate the loudspeakers and throw out leaflets. Then a flight to an outlying airstrip to meet a waiting American or Vietnamese psywar or intelligence officer, who would brief us on what they wanted us to do.

"At times, leaflets would be dropped over villages the Vietnamese government wanted targeted, other times the targets were Viet Cong units in specific locations or in a generalised area. In addition, we frequently broadcast a pre-recorded message over loudspeakers at the same target. The messages varied from instructions on where flood victims could go for food and shelter, to offers of amnesty and reward for surrendering with weapons.

"Several times a member of the VC defected with weapons, was welcomed warmly by the local military commander, given a cash reward for the weapons, photographed with a couple of attractive young ladies, and signed a statement telling how well he was being treated and suggesting his VC comrades join him. A leaflet would be prepared with his picture, statement and signature and a short message to his comrades recorded. And in less than six hours after the man had turned himself in, I, or one of the other U-10 pilots, was orbiting the VC unit broadcasting the message or delivering the leaflets. Reaction by the VC varied from no reaction to firing every weapon they had at us. Noise from the gunfire probably prevented many on the ground from hearing the loudspeakers."

Providers for the Air Commandos

As 1964 came to an end, the 1st ACW had four T-28s with 'Waterpump' in Thailand and 50 A-1Es, six C-47s, four U-10s and 44 C-123s in South Vietnam. The Fairchild C-123 Providers had been transferred from TAC and were first used by the 317th Air Commando Squadron, Troop Carrier at Hurlburt Field and the 19th Air Commando Squadron, Troop Carrier which was activated in October 1964 at Tan Son Nhut Air Base near Saigon. In March 1965 the 315th Air Commando Group, Troop Carrier was activated in South Vietnam with the 19th, 309th, 310th and 311th Air Commando Squadrons under its control, all flying the C-123.

The heavy workload in 1965 and early 1966 meant that aircraft maintenance suffered, as did the crews. They were under strength until the newly formed 4410th Combat Crew Training Wing came into being on 1 December 1965 at Hurlburt Field and increased the number of replacements flowing into Vietnam.

Aircraft losses increased over this period due to the poor airstrips into which the C-123s were flying. Four aircraft were lost during landings at An Loc, Tuy Hoa and Qui Nhon. The hillside strip at An Loc was a particularly bad place to land and half a dozen accidents were recorded in 1965/66, several resulting

The first psywar missions were entrusted to the U-10s of the 1st ACS, these aircraft also having a speaker in the door. The Courier was widely used on special transport operations, being able to land in very short and rough spaces.

In addition to loudspeaker missions, psywar tasks involved dropping leaflets over Vietnamese villages. U-10s were used in the early days, although later the C-47 picked up the tasking.

from collisions with helicopters sitting adjacent to the active airstrip. One C-123 landing at Dau Tieng struck a Chinook helicopter on one side of the runway and a UH-1D 'Huey' on the other.

Less forgiving, though rarer, were take-off accidents caused by engine failure. Three C-123s were lost in this way, the first at an airstrip in the Delta, although all 75 men on board survived the crash landing in the rice paddies. The other two occurred in 1966, and in the second of these 46 Americans died at An Khe, the base of the 1st Cavalry Division (Airmobile). Flying in poor visibility near mountains was another cause of aircraft losses. The C-123s lacked navigational radar and were used frequently for deliveries into the highlands. In mid-1965 a C-123 from the 310th ACS flew into a mountain while attempting airdrops in marginal weather south of Pleiku, with the loss of all nine on board. In December 1965 a C-123 flying in limited visibility from Pleiku to Tuy Hoa, without a navigator on board, struck a cliff-side and disintegrated. Eighty one Vietnamese paratroops and the four-man crew were killed. Another C-123 flareship was involved in a mid-air collision with an A-1E in January 1966, north of An Khe with the loss of six crewmen.

Into the valley of death

The first Medal of Honor for an Air Commando in Vietnam was won in March 1966, on a dark day for the US armed forces. American soldiers were rarely defeated in open battle, but that changed on 10 March when the North Vietnamese attacked the Special Forces camp in the A Shau Valley. The valley was a place to avoid; situated in I Corps Tactical Zone, 2 miles (3.2 km) from the Laotian border, it was part of a major Communist infiltration route from Laos eastwards towards the ancient capital city of Hue. The camp was surrounded by steep, jungle-covered mountains and manned by 17 Green Berets and 375 South Vietnamese Civilian Irregular Defence Group soldiers.

At 03.00 on 9 March the 95th NVA Regiment began a two-hour bombardment of the camp, followed by a probe of the camp's southern defences. The enemy had planned the attack well; bad weather hampered fixed-wing support and the camp was outside artillery range. The situation inside the camp was desperate and the defenders were sorely in need of more ammunition and medical supplies. Two C-123s from the 311th Air Commando Squadron, 'Harry's Hog Haulers', were given the task.

First Lieutenant Marc L. Bornn was one of the two aircraft commanders. "This particular camp was one of the 'sportier' locations to fly into. It sat at the south end of a 10-mile long valley that was up to 3,000 ft deep and extremely narrow, only half a mile wide in places. When I checked in on the Tactical FM frequency, I could tell that the situation on the ground was grave and that our cargo was sorely needed. However, the weather was terrible, solid cloud cover from 8,000 ft right down to within 50 to 300 ft of the valley floor, completely obliterating any landmarks and the mountains that surrounded the valley.

"Suddenly, a Skyraider popped up through the clouds, flown by Major Bernard Fisher from the 1st Air Commando Squadron, who said that he knew of a hole down through the clouds to the valley floor and thought he could lead us in. Our C-123s got on the tail of the Skyraider in a tight, almost vertical spiral, with the vertical speed needle hitting over 4,000 ft per minute! The turns had to be tight to stay VFR in the hole and not slam into the mountains. I put flaps, gear and full increase on the prop pitch in order to help slow the spiral dive. We finally made it down to the valley, pulling out of the dive at about 50 ft above the tree tops, cleaned the aircraft up (retracting the gear and the flaps) and started the run down the valley to the camp.

"The cloud ceiling at 100 to 250 ft above the trees made it seem as though we were flying in some dingy twilight tunnel due to the narrowness of the valley. I flew down the side of the valley, as close to the tree tops as possible, thus reducing our exposure to ground fire and hopefully ensuring that I would have enough room to execute a 180° turn if the clouds and fog became too severe. As we skimmed along toward our destination, we started picking up VC ground fire about 5 miles out. Looking out the open-sided cockpit window, I could actually see VC with their automatic rifles raised, firing at us as we passed over clearings.

"Through the misty gloom the camp now appeared, about a mile ahead, lying in a slightly wider portion of the valley. The only section of the camp still in friendly hands was a small triangular area, and this would be our Drop Zone (DZ). Major Fisher and his wingman in their Skyraiders, together with two B-57 Canberras from the 8th Bomb Squadron at Da Nang, were now making low-level strafing passes while we prepared to make our drop passes.

"All of the aircraft and the camp were on a common FM radio frequency so the radio chatter was continuous and from all directions. During this last mile coming in over the camp we started to pick up 12.7-mm and 20-mm anti-aircraft fire, in addition to the 0.30-in and 0.50-in machine-gun and small arms fire, and not only from below; from up on the valley walls as well, with some of the anti-aircraft guns almost firing down on us! It was like a classic anti-aircraft trap . . . they had us bracketed. Flying at tree-top level kept a lot of the gunners from getting a good bead on us; by the time they started to walk the tracer into us, we were gone and they were firing into the trees.

"We lined up for our first drop pass, pulled up to drop speed and to gain altitude so the chutes would open on the pallets. We were now at our most vulnerable. The tracer fire was

C-123s (right) were transferred to the Air Commandos for supply missions into outlying areas and flareship duties. One of the pilots, Lieutenant Marc Bornn, is seen below standing in front of his aircraft at the A Shau valley airstrip.

An A-1E of the 1st ACS receives attention at Da Nang in October 1966. Standard T.O.114 tactical camouflage was introduced to the fleet during the year for most types.

Right: Bernie Fisher and a relieved 'Jump' Myers are seen after the memorable mission to A Shau Valley. Fisher was awarded the Medal of Honor for landing to rescue Myers.

very heavy, criss-crossing in front of the nose and behind the aircraft. There was a sense of unreality about it: the red and green tracer rounds seemed to be floating at you like balls of cotton until they came abeam, and then they would accelerate at Mach 2 past you, all of this in a surreal miasma.

"On our first pass we dropped two of the 1,800-lb pallets on the DZ. I then dropped down to tree-top level and cranked a hard left turn, mostly skidded with the rudder so that I would not put the wingtip in the trees, and headed back up the valley, in order to give Mac Busby, in the other C-123, enough time to make his first drop and then to come hard around back over the DZ for his second drop. As he completed his second drop, and we were heading back for the camp again, we could see his aircraft completely bracketed by tracer. It was a wonder that he didn't take a hit. His last pallet missed the DZ and over the FM common frequency we heard that the VC were running to get it. One of the B-57 pilots punched his mike button and said, 'I'll take care of the bastards' and he rolled in and pickled off a napalm canister on the VC. Now the surroundings looked even more other-worldly with the added orange glow from the napalm. The friendlies were able to recover the pallet with this diversion.

"The camp radioed and advised us to abort our last drop pass, as the anti-aircraft fire on Busby's last pass had been so intense, but since we were within 20 seconds of the DZ we decided to press on, and we knew how badly needed the ammo and medical supplies were. Strings of tracer were streaming all around us as we cleared the last pallet; we applied maximum power to get out and that is when we took a hit. It sounded as though someone had fired a 0.45-in pistol right next to my ear. It was either a 12.7-mm or 20-mm high-explosive tipped shell and it hit us in the belly, just aft of the cockpit. The explosion tore a 12-in hole in the belly and turned the metal 'skate wheel' cargo rollers into shrapnel.

"Some of the shrapnel hit a large box of cargo tiedown chains that was positioned behind the cockpit and the remainder went up through the upper fuselage, taking with it two wire bundles which provided electrical power for all the cockpit instrumentation! The flight controls were not damaged and the plane handled normally. I could set the power by the sound of the engines, and keep the aircraft upright as long as I had reference to the ground. We had the most basic instruments left: needle, ball, airspeed indicator and whiskey (magnetic) compass for the climb out of the A Shau valley in the clouds.

Taking cover

"We were glad to leave the hostile arena below and climb up into the cloud cover, but we were not home free yet. We had to endeavour to keep the aircraft upright using the most basic of instruments and negotiate a narrow and precipitous mountain valley with a heading from a precessing magnetic compass. First Lieutenant David Hosley, our squadron paradrop navigator, gave me a heading to hold while we climbed out of the valley. We will never know how close or far we were from slamming into the valley wall, but when we topped the clouds at 8,000 ft, it was the brightest and most glorious sun that I had ever seen.

"Only 20 minutes had elapsed since we had plunged into the valley on Bernie Fisher's tail, but it seemed like an eternity. We got a radar steer back to Da Nang and landed uneventfully, to discover that we had also taken hits in the right prop and the tail." For his skilful flying that day, Marc Bomn was awarded the Distinguished Flying Cross.

The heavily outnumbered defenders managed to keep the enemy at bay for the rest of the day and night, and C-123s dropped almost 400 flares during the night to illuminate the area. At 04.00 on 10 March the NVA began their final assault, breaching the southern and eastern defences. With the enemy pouring into the compound, the defenders retreated across the runway to the communications bunker or into hastily built fighting positions along the northern wall. At 10.00 the detachment commander asked that the camp be strafed and bombed, with the exception of the communications bunker and the north wall.

By then another flight of Skyraiders had

The A-1Es initially served with the 1st ACS and 602nd Fighter Squadron (Commando). Later in the war the emphasis of Skyraider operations shifted to Nakhon Phanom for interdiction against the Trail and ResCAP operations.

The 'Spad' is best known for the Sandy ResCAP missions, providing rescue control and armed support for the helicopters. Here a 1st ACS A-1E formates on an HH-3E during a 1966 rescue operation.

arrived above the clouds and was looking for a way down. Fortunately, Major Bernie Fisher and his wingman, Captain Francisco 'Paco' Vazques, were back on the scene and they led the flight down through another hole in the clouds, followed by Wayne Dafford 'Jump' Myers, the detachment commander of the 602nd Air Commando Squadron, and Captains Hubert King, Jon Lucas and Dennis Hague.

As the Skyraiders made their first pass down the tube, a score of anti-aircraft weapons and hundreds of automatic weapons opened fire on them. Captain Hubert King's canopy was shattered, so he pulled up and headed for the nearest airfield. As Fisher led the two remaining Skyraiders back down the valley again, Major Myers felt his machine lurch.

He recalled, "I've been hit by 50-calibres before, but this was something bigger, maybe the Chinese 37-mm cannon.

"Almost immediately the engine started sputtering and cutting out and then it conked out for good. The cockpit filled with smoke. I got on the radio and gave my callsign, SURF 41, and said, 'I've been hit and hit hard.' HOBO 51, that was Bernie, came right back and said, 'Rog, you're on fire and burning clear back past your tail!' I was way too low to bail out, so I told him I would have to put it down on the camp airstrip."

As the blazing aircraft cleared the threshold Myers realised that he was going too fast to stop and raised his landing gear for a crash landing. The belly fuel tank blew as he touched down and a sheet of flame followed the aircraft as it skidded several hundred feet before coming to rest beside the runway. 'Jump' Myers climbed out of the cockpit, ran along the wing and sought shelter in the brush alongside the strip as the remaining Skyraiders made repeated strafing attacks to protect the fort and the downed airman. The Viet Cong were all around Myers and there was no time to wait for a rescue helicopter.

Fisher decided to land and pick up Myers himself. "I turned and touched down just about the end of the runway. I used all the brakes I could, but the strip was only 2,000 ft long. This was the only time I was scared, because it didn't look like I was going to be able to stop. I hit the brakes as hard as I could and pulled the flaps up, which gave me a little more weight on the brakes. I think I must have been skidding on that steel planking. It was a little bit slick from the dampness. I actually went off the end of the runway a little ways. There were a lot of 55-gal drums sitting out in the reeds and in my mind I was sure I would hit them. My tail did when I turned, but the wing went right over the tops of them."

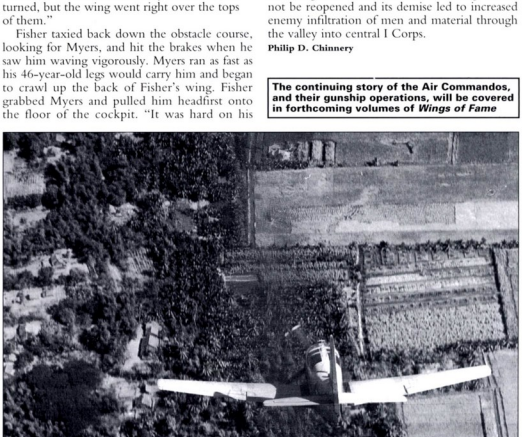
Fisher taxied back down the obstacle course, looking for Myers, and hit the brakes when he saw him waving vigorously. Myers ran as fast as his 46-year-old legs would carry him and began to crawl up the back of Fisher's wing. Fisher grabbed Myers and pulled him headfirst onto the floor of the cockpit. "It was hard on his head, but he didn't complain," said Fisher later.

Major Fisher accelerated down the strip, dodging the shell craters and debris, and lifted off, heading for Pleiku Air Base in his Skyraider which had been hit 19 times. On 19 January 1967 President Johnson awarded Bernie Fisher the Medal of Honor. He was the first Air Force member to receive the medal for action in Vietnam.

The remaining Skyraiders had continued to bomb and strafe the enemy until they ran out of ammunition. After the battle, 300 enemy bodies were counted along the wall of the A Shau outpost. That evening the camp was abandoned. Losses were high: a total of 248 members of the garrison were dead or missing, including five Green Berets. The camp would not be reopened and its demise led to increased enemy infiltration of men and material through the valley into central I Corps.

Philip D. Chinnery

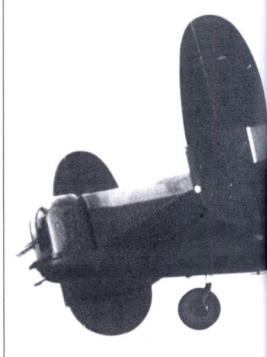
The continuing story of the Air Commandos, and their gunship operations, will be covered in forthcoming volumes of *Wings of Fame*



This dramatic 1965 photograph depicts an A-1E diving on to a target which had been marked by a FAC. The Skyraider proved able to deliver ordnance with far greater accuracy than the fast jets which had arrived in-theatre in numbers.

The 'Dambusters'

No. 617 Squadron, RAF



Youngest of the operational squadrons still serving in the Royal Air Force, No. 617 is certainly one of the most famous. Its prestige stems almost entirely from a single wartime operation: the extraordinary dams attack of 16/17 May 1943, led by the legendary Guy Gibson. Building on this enviable reputation, No. 617 Squadron went on to win new laurels in the great bomber offensive of 1943-45, and in post-war years was in the forefront of the RAF's advance into the supersonic and nuclear eras.

Above: The aircraft that will forever be linked with No. 617 Squadron is the Avro Lancaster in modified 'Type 464 Provisioning' form. This aircraft did not fly on the raid itself, the 'actual' AJ-C (ED910/G) being shot down near Hamm.

Above left: The Möhne dam was the most important in Germany and the Air Staff had considered its destruction since 1937. Together with the Eder and Sorpe dams, the Möhne provided most of the water and electricity for the industrial heartland of the Ruhr Valley.

Considerable mythology surrounds the birth of No. 617 Squadron, assisted by contemporary wartime propaganda and subsequent ill-informed dramatisation. The unit originally selected to introduce special weapons into service with Bomber Command was in fact No. 106 Squadron, flying Lancasters under Wing Commander G. P. Gibson from May 1942 at Coningsby in Lincolnshire. Its choice lay in the fact that at that time this squadron headed the No. 5 Group 'bombing ladder' – the criterion by which the leading squadron (in terms of bombing accuracy) was identified.

Part of this squadron, C Flight, was first given the task of introducing into service the Capital Ship Bomb (CSB), a weapon that had been under development for about two years. It was originally intended for the Avro Manchester, which was the only bomber destined for Bomber Command that had an uninterrupted bomb-bay large enough to accommodate the new bomb. When the Manchester fell by the wayside and the Lancaster emerged as the superior aircraft, it was found that, despite the size of the Lancaster's bomb bay, it would require bulged bomb doors. (The modified Lancasters were codenamed Provisioning as a means of concealing their purpose.) Much hope was pinned on this novel weapon, which was designed to penetrate the armoured decks of Germany's capital ships before discharging a heavy carbon-steel disc through the bottom of the ship.

Special squadron, special mission

However, the single raid undertaken by No. 106 Squadron and led by Gibson against the German naval vessels in the Polish port of Gdynia on 27/28 August 1942 proved a failure. Despite the aircraft carrying some of the best bomb-aimers in the command, all the CSBs missed their targets by large margins owing to their erratic trajectories and therefore the impossibility of accurate aiming. As a result, the CSB was virtually abandoned, a failure that was later to influence the operational use of special weapons, as well as colouring Air Chief Marshal Sir Arthur Harris's attitudes towards 'special squadrons' and special weapons.

No. 106 Squadron was then given the difficult job of introducing the new 8,000-lb (3630-kg) HC bomb (the heaviest yet produced), and succeeded in carrying the weapon over the Alps to targets in northern Italy, which at that time (late 1942) was an outstanding achievement. Again, Gibson was usually in the lead Lancaster.

Unfortunately, being a line squadron in No. 5 Group, No. 106 Squadron's special role could not be guaranteed complete secrecy. When plans were being drafted to attack the dams in central Germany with Dr Barnes Wallis's rotating mines (the so-called 'bouncing bombs' codenamed Upkeep), it was deemed prudent to distance No. 106 Squadron's 'C' Flight from its parent unit and to give it a new squadron identity; No. 617 was the next vacant squadron number. This was a fairly common practice in Bomber Command when new squadrons were formed. So as not to remove all the best crews from No. 106, Gibson (who commanded 617) was allowed to pick any crew he wished from the remainder of the group and, with one or two exceptions, acquired a truly outstanding complement of pilots and crews.

Redeployed on 21 March 1943 to Scampton, also in Lincolnshire, the new squadron began low-level training almost immediately, using standard Lancasters initially. This flying contin-

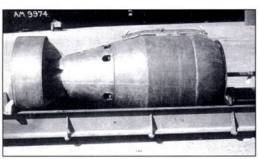
Right: Post-war, the glory days of the 'Dambusters' were as a constituent part of V-Force equipped with the magnificent Avro Vulcan. The squadron maintained a round-the-clock alert for a decade, chiefly equipped with the Blue Steel missile.

ued for several weeks, culminating in dummy attacks on several dams in Britain. No inkling of the eventual targets was given to the crews (other than Gibson himself), and the rumour – perhaps natural enough among the No. 106 Squadron veterans – soon spread that the training was for attacks against enemy naval vessels. Shortly before the raid itself, which took place on the night of 16/17 May 1943 (at the height of the Battle of the Ruhr), special Lancasters together with the mines were delivered to Scampton. The bomb doors had been removed from the aircraft so that the large cylindrical mines could be suspended between a structure which incorporated a spinning mechanism; the mines were intended to be released while spinning on their longitudinal axes, the backward spin imparting a series of decelerating bounces on the water so calculated to enable the mine to come to rest against the dam's parapet before sinking to a predetermined depth where it would explode against the face of the dam.

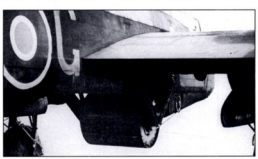
The story of the raid is by now well known. Of how the problem of maintaining an accurate height of only 60 ft (18.3 m) over water at night was solved by fitting downwards-shining

No. 617 Sqn supplied crews for Operation Granby, the RAF's participation in the 1991 Gulf War. The detachment at Tabuk was initially established as No. 617 Sqn (Composite) under the command of Wing Commander Bob Iveson, the squadron's CO.

Guy Gibson, CO of No. 106 Squadron (front centre, to right of dog), is seen with his aircraft and his crews. Eighteen of these crewmen were to form the core of No. 617 Squadron. The presence of naval officers suggests that this picture dates from the time of the Gdynia Harbour raid in August 1942.



Above: The Capital Ship Bomb was designed to penetrate the armoured decks of large warships before exploding. Proving hard to aim accurately, its one operational use was a failure: the four bombs landed on Gdynia, and in its harbour rather than on the target ships.



Above: 'Upkeep' was the rotating depth charge or 'bouncing bomb' used to attack the dams, here fitted to Gibson's aircraft. It weighed 9,250 lb (4195 kg) and contained 6,600 lb (2994 kg) of Torpex explosive. Note the drive band which imparted the essential 500 rpm backspin.

spotlights from the aircraft, their beams angled to converge and meet when flying at that exact height above the water. Of the plan to split the raiding force between three of the dozen or so dams in central Germany: the Möhne, Eder and Sorpe. Of the use of the codename Nigger, to be transmitted home if and when the Möhne dam was destroyed. And so on. What is perhaps less well-known is that, from exact records kept by the German authorities, it has emerged that neither Gibson nor Martin (his deputy leader) hit the Möhne: both aircraft released their mines while banking slightly, with the result that both weapons slewed to one side. Only one mine exploded accurately against this dam (probably that of Maltby), and this alone proved adequate to breach the great structure, thereby confirming Barnes Wallis's forecast that only one mine, accurately placed, would be required to destroy the dam.

Two dams down

A similar train of events occurred at the Eder dam. According to German records, only the mine dropped by the last but one aircraft to attack (that flown by David Shannon) actually exploded against the dam, blasting a hole in the structure well below the parapet. The dam had already started to collapse before the final Lancaster attacked, and its mine exploded about 400 yd (365 m) from the dam. At the Sorpe, two crews believed that they had attacked their target (which was not breached), but one of these, captained by Townsend, can only have attacked the Ennerpe dam instead – according to his log entries and the bearing on which he stated he had attacked in relation to the moon. His attack also failed.

Out of 19 aircraft which set out to attack the dams, eight failed to return. Gibson was awarded the Victoria Cross for his exceptional leadership and gallantry during the attack. Other awards were made, including the Conspicuous Gallantry Medal to Townsend (the CGM was widely regarded as 'the NCO's Victoria Cross'); his return across Germany in the gathering dawn was an epic in itself.

Morale-booster

Arguments have raged ever since as to the true value of the raid, bearing in mind the heavy casualties among the valuable crews. The choice of the Eder and Sorpe (the former not in any way concerned with the Ruhr industries) is certainly open to question. Yet the raid occurred at a critical stage in the war. The fact that British heavy bombers could penetrate into the heart of Germany and 'take out' isolated strategic targets provided a much-needed tonic for the British nation, as well as demonstrating to the Americans that such raids could be carried out with great accuracy by the RAF at night, and that Bomber Command was not merely an instrument with which Churchill was setting about to systematically lay waste to German towns and cities in the hope of hitting military and industrial targets in the process. It was also an operation warmly applauded by the hard-pressed Russians.

The Upkeep weapons were not employed again, and after a brief rest – spent re-equipping with standard Lancasters and training replacement crews – No. 617 joined the Main Force of Bomber Command. Gibson was posted away, only to be shot down and killed later in 1943. Command of the squadron passed to Squadron Leader G. W. Holden, DSO, DFC, but it was not until July 1943 that No. 617 Squadron returned to operations with an attack on targets in northern Italy, after which the pilots flew on to North Africa to refuel before

Gibson (on step) and his crew board AJ-G on the way to the Möhne dam – and history. From left to right: Trevor-Roper (rear gunner); Pulford (flight engineer); Deering (front gunner); Spafford (bomb aimer); Hutchison (wireless operator); and Taerum (navigator). None were to survive the war.

Above: A photo taken from a German soldier in Normandy shows the breach in the Möhne dam. The two dams destroyed in Operation Chastise were repaired to some degree by the following winter (although not completely before 1946/47). One of the main results of the dams raid was that 10,000 personnel were redirected to defending all Germany's dams against a repeat attack.

***Right: Within hours of the dams aircraft landing, a PR aircraft brought back pictures of the devastation wrought by the flood waters. On 18 May, these pictures would begin to appear in the world's newspapers. On 27 May, King George VI visited Scampton, viewed the reconnaissance photographs and approved a suggested squadron badge and motto:* 'Après Moi, le Déluge'.**

returning to England. Despite its unusual route, morale on the squadron sank as the crews yearned for more exacting duties. In truth, the squadron's future was being decided at Bomber Command HQ, with a strong lobby arguing against the continuation of No. 617's elite status. Nevertheless, no-one could deny that set-piece raids had brought about some spectacular results (as witness the low-level daylight attack by Nos 44 and 97 Squadron Lancasters against the MAN diesel engine works near Augsburg on 17 April 1942).

Precision targets

In August, No. 617 moved to Coningsby (No. 105's old station) amid rumours that it was to become a 'normal' Main Force squadron. This was not to be, and in the following month Holden led a low-level attack against the Dortmund-Ems Canal by eight 617 Lancasters. Air Vice Marshal the Hon. R. A. Cochrane, who had assumed command of No. 5 Group in February 1943, had won his argument that the squadron should retain its special status. Accordingly, the eight aircraft carried the new 12,000-lb (5440-kg) HC (High Capacity – thin case) bomb for the first time. The attack was disastrous: Holden was shot down by flak before reaching the canal, and four other Lancasters also failed to return. The canal was not seriously damaged despite the size of the bombs – they were designed to demolish buildings with their blast, not destroy substantial structures or earthworks, such as canal banks. Moreover, four of Gibson's former crew members were flying with Holden, and all were lost. Knight, Shannon and Martin, all veterans of the dams raid, were the three surviving captains.

Holden's successor was perhaps the most famous RAF bomber pilot of all time, the great Leonard Cheshire, then aged 25 and the youngest group captain in the service. When he arrived on No. 617, he had already won two DSOs and the DFC, and at that time the squadron was practising the use of a new bomb-sight which showed all the signs of being exceptionally accurate. During the winter of 1943-44, No. 617 began attacks on the flying-bomb launch sites that were springing up all over the Pas de Calais, difficult targets to identify on account of their small size and careful camouflage. To assist the Lancaster bomb-aimers – now very proficient with their new bombsight – Mosquitos of the Pathfinder Force (No. 8 Group), using the exceptionally accurate Oboe radar equipment, led the attack by marking the targets; after a number of disappointing results, the launch sites began to be put out of action. Unfortunately, the sites were being completed by the score, and there was only one No. 617 Squadron.

Experience had shown that even the Pathfinders were not faultless, and Cheshire decided that No. 617 would do its own target marking. He evolved his own tactic by which he himself would approach the target at very low level and somewhat ahead of the squadron's other bombers. Once he had identified the target (often having to dodge extremely heavy and accurate flak), he would put down his flares or coloured markers before calling in the Lancasters high above. And he would remain circling the target, acting as a 'master of ceremonies', broadcasting the accuracy of the bombing to the crews above so that they could shift their aim when necessary.

By now the squadron was achieving unbelievable accuracy, both in navigation and in

After the medal investiture ceremony at Buckingham Palace on 22 June, Lancaster builders A.V. Roe and Company (Avro) threw a party at the Hungaria Restaurant in Regent Street. Most of the 34 decorated aircrew were there, including Gibson (front row, third from right). Also present were Barnes Wallis (front row, far left), Mutt Summers (behind Wallis in light jacket) and T.O.M. Sopwith (above Summers). Lancaster designer Roy Chadwick is standing at extreme right.

One of the first Lancaster B.Mk I (Special)s, PB996, drops a Grand Slam as part of the trials programme. This may be 13 March 1945, date of the first live drop. A day afterwards, No. 617 took the giant bombs into action and cut the Bielefeld viaduct. The blanking plate for the upper turret can be seen.

bombing. As a demonstration of the former, the squadron was selected to fly Operation Taxable during the night of 5/6 June 1944, as the massive Allied invasion fleet was approaching the Normandy beaches. This involved a widely spaced 'formation' of Lancasters flying a pattern of oblongs, the turns being very accurately synchronised so as to give the appearance on enemy coastal radar of an approaching invasion force. Dropping numerous bundles of 'window' – small strips of metal foil, which appeared on enemy radar indistinguishable from aircraft or ships – also at very accurate intervals, the Lancasters' 'pattern' advanced towards the coastline of the Pas de Calais at a speed of about 4 kt (4.5 mph; 7.4 km/h), giving all the indications of the approach of a major Allied invasion fleet, whereas the real landings were taking place 100 miles (160 km) away.

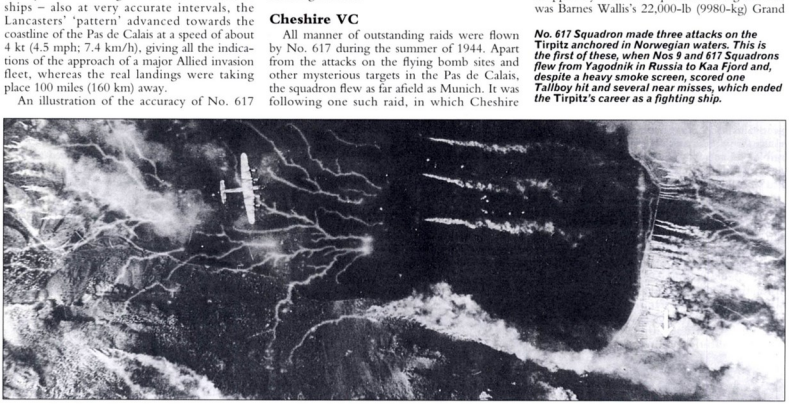
An illustration of the accuracy of No. 617 Squadron's bombing is afforded by the squadron's attack on the Saumur railway tunnel in northern France shortly after the Normandy landings. Of course, the path of the railway inside the tunnel was invisible from the air, and only the entrances could be discernible at night. Using Tallboy 12,000-lb (5440-kg) DP (deep penetration) bombs for the first time, No. 617 was able to penetrate many feet of earth to the tunnel below, while other bombs brought down the roofing on to the railway, effectively blocking the line.

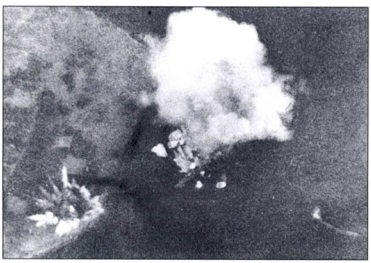
Cheshire VC

All manner of outstanding raids were flown by No. 617 during the summer of 1944. Apart from the attacks on the flying bomb sites and other mysterious targets in the Pas de Calais, the squadron flew as far afield as Munich. It was following one such raid, in which Cheshire attracted the full fury of the ground defences while he circled the target calmly directing the bombing, that he was awarded the Victoria Cross. This award was unique in that the citation merely pointed to the hazardous nature of the Munich action as an example in the awesome list of occasions on which Cheshire had displayed astonishing bravery, spanning four years in which he had completed 100 operations.

One more devastating 'special weapon' dropped by No. 617 Squadron during the war was Barnes Wallis's 22,000-lb (9980-kg) Grand

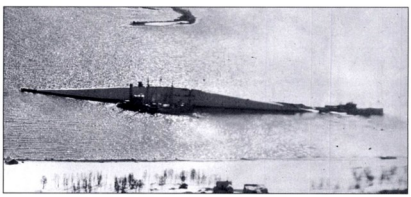
No. 617 Squadron made three attacks on the* Tirpitz *anchored in Norwegian waters. This is the first of these, when Nos 9 and 617 Squadrons flew from Yagodnik in Russia to Kaa Fjord and, despite a heavy smoke screen, scored one Tallboy hit and several near misses, which ended the* Tirpitz*'s career as a fighting ship.



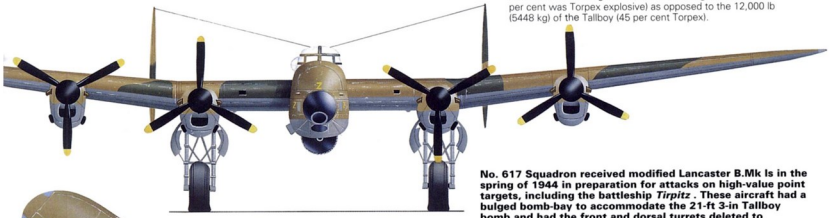


Left: The* Tirpitz *was moved to Tromsö, where another attack was made but no hits scored. On 12 November, the two squadrons returned and hit the great ship with at least two Tallboys.

Below: The* Tirpitz *was wracked by an internal explosion and capsized with the loss of about 1,000 crew. To this day, Nos 9 and 617 Squadrons argue about who struck the fatal blow.



Grand Slam
The Grand Slam weighed 22,000 lb (9980 kg) (of which 42 per cent was Torpex explosive) as opposed to the 12,000 lb (5448 kg) of the Tallboy (45 per cent Torpex).



No. 617 Squadron received modified Lancaster B.Mk Is in the spring of 1944 in preparation for attacks on high-value point targets, including the battleship *Tirpitz* . These aircraft had a bulged bomb-bay to accommodate the 21-ft 3-in Tallboy bomb and had the front and dorsal turrets deleted to compensate for its great weight. Extra fuel tanks were added for the *Tirpitz* operations, bringing the total to 2,406 Imp gal (10938 litres). In March 1945, the squadron began operations with the Grand Slam, which required a further modified aircraft to carry it. The new bomb was only 5.5 ft (1.7 m) longer and 8 in (20 cm) greater in diameter but 10,000 lb (4535 kg) heavier. The new aircraft had no bomb doors at all. These aircraft were designated B.Mk I (Special) and the first of 33 built flew in February 1945.

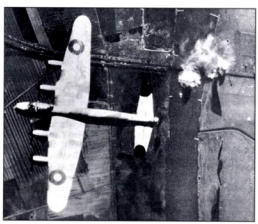
Grand Slam in action
Forty-one of the giant bombs were dropped by No. 617 Squadron during the war, and others afterwards by No. 15 Squadron, who inherited the modified Lancasters and tested the weapons against U-boat pens and other fortifications in the formerly occupied countries. The Grand Slam remains the heaviest bomb ever dropped in action.

Lancaster B.Mk I (Special) No. 617 Squadron Woodhall Spa March 1945

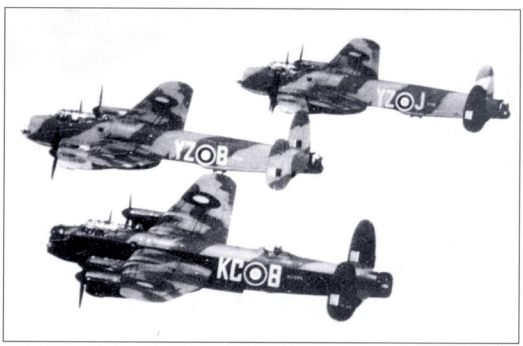
Markings
The colour of the code letters reversed the common Bomber Command pattern of red with yellow edging, and these were repeated both above and below the tailplanes. As a further identification measure the 'Specials' wore 'YZ' codes and the B.Mk Is and B.Mk IIIs the usual 'KC'.

Special tactics
With the adoption of daylight missions by the RAF's heavy bomber force in the last part of the war, new tactics, similar in some ways to those used by the 8th Air Force, were introduced. Although the threat of enemy day fighters was much reduced by late 1944, a vertically-staggered formation of three 'vics' of four, known as the 'gaggle', was adopted for mutual defence during Tallboy and Grand Slam attacks. The standard B.Mk III aircraft with a full complement of guns escorted the 'Specials'. High altitude was used for the pinpoint attacks as it gave the greatest bomb penetration before detonation – 100 ft (30.5 m) into soil with a Tallboy dropped from 20,000 ft (7000 m).

Camouflage
The new daylight formation tactics used on set-piece attacks led to the introduction of bolder identification markings and a distinctive new colour scheme on the B.Mk I (Specials). The bulk of the aircraft assigned to No. 617 Sqn retained the standard night-bomber colour scheme with dull red codes, but the 'Specials' were painted in matt dark earth and dark green with ocean grey undersides.



Above: As well as the dams and the* Tirpitz, *No. 617 Squadron gained a reputation for severing viaducts and tunnels. On 19 March 1945, six Grand Slams were dropped on the Arnsberg viaduct, blowing out a 40-ft (12-m) stretch.



Above: In the last two months of the war, the squadron was flying Grand Slam missions with two distinct subtypes of Lancaster, including 'KC'-coded B.Mk I/IIIs.

Left: As well as Lancasters, No. 617 operated a single Mustang Mk III and various Mosquitoes for target marking.

Slam deep penetration bomb. By the time this arrived on the squadron, early in 1945, Cheshire's command had passed to Willie Tait, a 26-year-old Welshman who, by the end of the war, had won no fewer than four DSOs. During his tenure of office, No. 617 Squadron paid three visits to the German battleship *Tirpitz*, lying at anchor in Norwegian waters. The first, in which No. 617 flew to a Russian airfield in September, so as to reduce the distance to be flown, was defeated by the German smokescreen which concealed the target in the nick of time. One Tallboy, however, had been dropped, and hit the *Tirpitz* on the fo'c'sle; although this did not prove fatal, it forced the Germans to move the battleship south to Tromsö for repairs, 200 miles (320 km) closer to a base in Britain. A second attack was made, flying from Lossiemouth and in company with No. 9 Squadron (also carrying Tallboys), but this was frustrated once again, this time by bad weather. Finally, on 12 November, again led by Tait and flying with No. 9 Squadron from Lossiemouth, the third attack was rewarded by success as half a dozen Tallboys either struck or narrowly missed the great ship which, as the bombers turned for home, appeared to be capsizing, an end that was confirmed shortly afterwards by an RAF reconnaissance aircraft. Early in January 1945 Tait's command of No. 617 Squadron passed to a Canadian, Group Captain J. E. Fauquier, DSO and BAR, DFC.

The 22,000-lb Grand Slam bombs were used only sparingly in the final weeks of the war, in setpiece attacks against targets in Germany by No. 617, such as the Bielefeld viaduct (on 14 March), the Arnsberg viaduct (on 19 March), the Nienberg bridge (on 22 March), the Bremen railway bridge (on 23 March) and the Arbergen bridge over the Weser (on 25 March). In a successful attack on the Farge submarine pens, No. 617 Squadron led about 100 Main Force Lancasters, two of its Grand Slams penetrating and bringing down the massive reinforced concrete shelter roof.

Principal operations flown by No. 617 Squadron in World War II

Date	Target	Weapon(s)	Notes
16/17-5-43	Dams (Operation Chastise) *	Special mines (Upkeep)	Two dams destroyed
15/16-7-43	San Polo d'Enza (power stations)	8,000-lb HC	Not successful. Flew on to Africa
24/25-7-43	Leghorn	8,000-lb HC	Return from Africa shuttle
15/16-9-43	Dortmund-Ems Canal *	8,000-lb HC	5/8 aircraft lost
16/17-9-43	Antheor Viaduct	8,000-lb HC	No direct hits
11/12-11-43	Antheor Viaduct *	12,000-lb HC	No hits
16/17-12-43	SOE Special Target *	12,000-lb HC	Poor marking – no hits
30/31-12-43	Special Target, France *	12,000-lb HC	Poor marking – no hits
8/9-2-44	Limoges	GP bombs	Low-level marking – very destructive
18/19-4-44	Juvisy Railyards	GP bombs	Successful
24/25-4-44	Munich	GP bombs	Successful
3/4-5-44	Mailly-le-Camp	12,000-lb HC	Successful
5/6-6-44	Operation Taxable *	nil	(Spoof operation, D-Day)
8/9-6-44	Saumur Tunnel *	12,000-lb DP (Tallboys)	Tunnel destroyed
31-7-44	Rilly-la-Montagne (V-1 store in tunnel) *	12,000-lb DP (Tallboys)	Tunnel destroyed
11/12-9-44	*Tirpitz* (Kaa Fjord)*	12,000-lb DP (Tallboys)	*Tirpitz* heavily damaged
23/24-9-44	Dortmund-Ems Canal *	12,000-lb DP (Tallboys)	Canal breached
7/8-10-44	Kembs Dam locks *	12,000-lb DP (Tallboys)	Locks destroyed
29-10-44	*Tirpitz* (Alten Fjord) *	12,000-lb DP (Tallboys)	*Tirpitz* lightly damaged
12-11-44	*Tirpitz* (Alten Fjord) *	12,000-lb DP (Tallboys)	*Tirpitz* sunk
12-1-45	Bergen (U-boat pens)	12,000-lb DP (Tallboys)	Pens damaged, minesweeper sunk
14-3-45	Bielefeld Viaduct *	22,000-lb DP (Grand Slams)	Viaduct partially collapsed
15-3-45	Arnsberg Viaduct *	22,000-lb DP (Grand Slams)	Viaduct not cut
22-3-45	Nienburg Bridge *	Tallboys and Grand Slams	Bridge destroyed
23-3-45	Bremen Bridge *	22,000-lb DP (Grand Slams)	Bridge hit
27-3-45	Farge U-boat pens *	Tallboys and Grand Slams	Pens destroyed
25-4-45	Berchtesgaten	12,000-lb DP (Tallboys)	Bombing accurate

* Special or Setpiece Operation

Keeping the peace

The end of the war in Europe released many RAF squadrons for service in the Far East to help in the defeat of Japan. However, the majority of aircraft designed and built for service in Europe were unsuited for operations in Southeast Asia and over the Pacific, largely on account of the great distances involved. This situation had to some extent been foreseen and the Lincoln heavy bomber was intended for service against Japan. When it became apparent that the Lincoln was still some months from service when Nazi Germany surrendered, plans were hastily made to send a small number of Lancaster squadrons to India as part of Tiger Force. Among them was No. 617, which left its peacetime station at Waddington to fly to Salbani, arriving in India during January 1946 with Lancaster VIIs – too late to fly operations against Japan. Returning to Britain in May, it

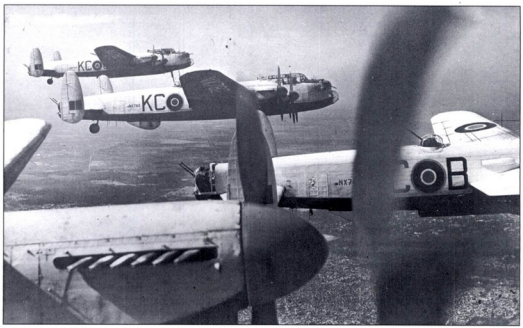
Post-war, the squadron was re-equipped with Lancaster Mk VIIs (in Far East camouflage) and was based at Salbani in India between January and June 1947. NX791 is seen at Digri. Lancaster Mk VIIs were fitted with Martin top turrets.

took up station at Binbrook where, four months later, it received its first Lincolns.

During the summer of 1947, No. 617 Squadron accomplished the first direct crossing of the Atlantic by an RAF squadron, en route for a goodwill visit to Canada and the USA where it paid courtesy calls on eight of the major bases of the USAF as well as to Trenton, Ontario. Still equipped with Lincolns in 1950, No. 617 Squadron won the annual Bomber Command Bombing Competition, subsequently parading at Buckingham Palace to receive the Laurence Minot Trophy

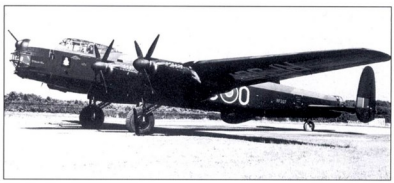
Into the Jet Age

Handicapped by severe limitation of defence appropriations for some years after the war, the RAF was denied the opportunity to keep pace with the USA in aviation technology. Despite the pioneering work done by Britain in gas turbines, the RAF was prevented from acquiring advanced bombers during the early 1950s and the Canberra, adequate though it was when it



Above: A formation of No. 617 Squadron Lancaster Mk VIIs overflies Benares in India.

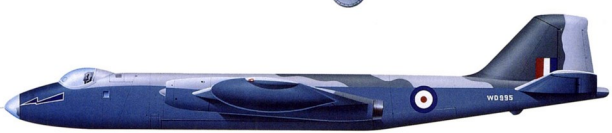
Right: From September 1946 to January 1952, No. 617 flew the Avro Lincoln from Binbrook. An extensive tour of the US was undertaken in July-September 1947. Detachments in Egypt and Libya were also made.



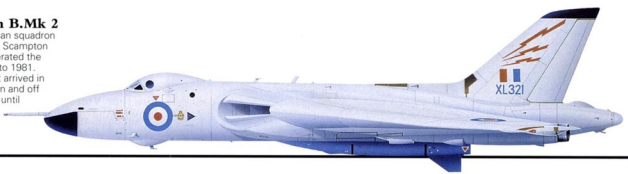
No. 617 Squadron bombers

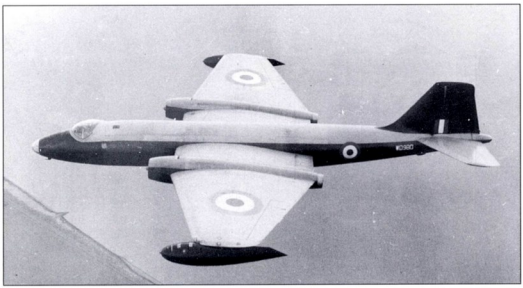
Avro Lancaster B.Mk III
The first and most famous type used by No. 617 Squadron was the Lancaster B.Mk III modified for the dams raid. This aircraft was the one flown on Chastise by P/O L.G. Knight RAAF, who breached the Eder dam.

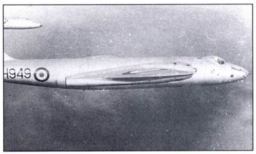
English Electric Canberra B.Mk 2
The 'Dambusters' were the second RAF squadron to receive the Canberra (after No. 101) and flew B.Mk 2s and B.Mk 6s from 1952 to 1955. Each squadron of the Binbrook Wing wore a different coloured lightning flash on the nose, No. 617's being dark blue.



Avro Vulcan B.Mk 2
The third RAF Vulcan squadron and the first of the Scampton Wing, No. 617 operated the Vulcan from 1958 to 1981. B.Mk 2 XL321 first arrived in 1962 and served on and off with the squadron until disbandment.

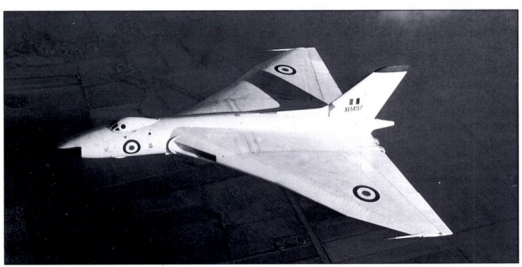






Left: The first jet for the 'Dambusters' was the English Electric Canberra B.Mk 2. Together with Nos 9 and 101 Squadrons, the squadron formed the Binbrook Wing, which was the first RAF formation to receive the new bomber.

Above: With the improved Canberra B.Mk 6, No. 617 Squadron was in action once again in Malaya. The action was of a low intensity, with little danger from the enemy, and after a five-month deployment the squadron returned to the UK to the news that it faced imminent disbandment.



Left: After 17 months of dormancy, No. 617 was reborn as a part of V-Force and re-equipped with the Vulcan B.Mk 1. On 21 June 1961, a squadron aircraft broke the England-Australia record with a flight of just over 20 hours.

entered service in 1951, was soon found to lack significant development potential. No. 617 Squadron, still at Binbrook, was the second in Bomber Command to receive the Canberra B.Mk 2 (after No. 101 Squadron), in January 1952, aircraft which were replaced by the Mk 6 in February 1955. It was with these more powerful Canberras that the squadron was detached to Malaya, based at Butterworth for four months of operations against the Communist guerrillas before returning to Binbrook, where it was disbanded on 15 December that year.

V-Bomber squadron

If the period between 1951 and 1955 was not particularly auspicious for a squadron that had gained unequalled laurels in war, May 1958 represented a renaissance for No. 617 Squadron. Reformed at Scampton (of immortal 'dams raid' fame) on 1 May, the squadron began taking delivery of the Avro Vulcan B.Mk 1 four-jet delta-winged medium bomber as part of the V-Force, the RAF's nuclear deterrent. The following year the squadron swept the board by winning the Laurence Minot Medium Bomber Force Bombing and Navigation Trophy, the Sassoon Medium Bomber Force Navigation Trophy, and the Navigation Bombing System Trophy, becoming the first squadron to win all three of the premier awards available to a bomber squadron. In June 1961 Squadron Leader M. G. Beavis, flying Vulcan B.Mk 1A XH481, established a new point-to-point speed record between Britain and Australia by flying non-stop the 11,500 miles (18500 km) between Scampton and Sydney in 20 hours 3 minutes – an average speed of 575 mph (925 km/h) – an achievement made possible by refuelling in flight three times. During the period in which No. 617 Squadron flew Vulcan B.Mk 1s, its designated nuclear weapon was Blue Danube, an 0.5-MT nuclear bomb weighing approximately 10,000 lb (4535 kg).

What transpired as the final chapter in the RAF's long-range strategic bombing potential by manned aircraft was entered upon by No. 617 Squadron in September 1962 when it was joined by the Vulcan B.Mk 2. It was destined to become operational in February 1963 with Britain's Blue Steel nuclear-armed stand-off weapon, weighing 15,000 lb (6800 kg), with a 1-MT Red Snow warhead. In both 1962 and 1963 the squadron again won the prestigious Sassoon Trophy.

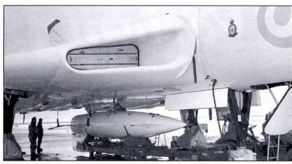
However, by the time the Blue Steel weapon entered service it had already been pre-empted by international events. In 1960 the Soviet Union had demonstrated its ability to destroy potentially hostile intruders into its air space when an American U-2 strategic reconnaissance aircraft was shot down by a surface-to-air missile while flying over the Soviet Union at about 80,000 ft (24385 m). Possessing a service ceiling of around 60,000 ft (18290 m), the British bombers were clearly fatally vulnerable if operated against such defences; in fact, the whole V-Force philosophy was collapsing. Within three years the role of the British V-Bombers was drastically changed to that of low-level attack in the belief that this tactic stood the best chance of escaping detection by enemy radar. While Blue Steel continued to be carried – modified for low-level release – new weapons were brought into service with thermo-nuclear warheads, intended to be launched from a loft or off-set lay-down manoeuvre.

The next set-back occurred in the mid-1960s when it was discovered that the Valiant (oldest of the RAF's V-Bombers) was chronically susceptible to wing structure fatigue, a situation exacerbated when operating in the punishing low-level role. As it was not considered economical to introduce extensive modifications to the old aircraft, the Valiants (including those engaged in the inflight-refuelling role) were summarily grounded, their place in the latter being taken by Victor tankers.

From Vulcan to Tornado

With the demise of Handley Page, the Victors were eventually tasked exclusively with this role, effectively leaving the Vulcans as the sole medium bombers in the new Strike Command. By 1 January 1975 this command possessed seven Vulcan B/SR.Mk 2 squadrons, of which No. 617 Squadron shared the Scampton base with No. 27 Squadron. Blue Steel was withdrawn from service in 1968 as the Royal Navy assumed the nuclear deterrent responsibility, and No. 617 Squadron reverted to conventional low-level bombing until 31 December 1981 when it was disbanded.

The squadron was therefore not available to participate in the Falklands campaign of 1982, the four Vulcans that were involved being drawn from the Waddington Wing. However, on 16 May 1983, No. 617 Squadron was reformed under the command of Wing Commander Tony Harrison at Marham to



Above and left: The Vulcan B.Mk 2 replaced the B.Mk 1 in September 1961, the primary armament being the Blue Steel, initially employed as a high-altitude weapon. With a change to the low-level Blue Steel mission, the Vulcans gave up their anti-flash white scheme for camouflage.

become Strike Command's second Tornado GR.Mk 1 squadron (after No. 9 Squadron). Originally intended to become a Canberra replacement with the RAF, the two-seat Tornado was essentially a strike/reconnaissance aircraft with a supersonic performance, and was destined to become the RAF's standard aircraft performing this role (although in certain circumstances the ageing Buccaneer complemented it in operational service for another decade).

No sooner had No. 617 Squadron been declared operational that it leapt back into the headlines when, in October 1984, the squadron carried off two of the three major trophies in the US Strategic Air Command's Bombing Competition (Operation Prairie Vortex) at Ellsworth Air Force Base. This annual competition was designed primarily to suit the operational tasks of the USAF, and therefore previously had been dominated by American B-52s and F-111s. To emphasise No. 617's superiority – not to mention the excellence of its Tornados – the squadron gained the highest-ever points in the Curtis E. LeMay Trophy and the John C. Meyer Trophy, and were placed second in the Mathis Trophy. (Aware of No. 617 Squadron's long-established prestige, stemming from the wartime dams raid, the Americans were not convinced that the squadron had not deliberately assembled a group of expert pilots and navigators from the whole RAF just for the purposes of this competition. The following year No. 27 Squadron, a much lesser-known line squadron – also based at Marham with Tornados – represented the RAF in the 1985 SAC Bombing Competition, and eclipsed even the performance of No. 617 by taking first and second places in both the LeMay and Meyer Trophies, and second place in the Mathis trophy, only losing first place when a bomb hung up.)

The Saddam-busters

Much more recently, No. 617 Squadron was involved in Operations Desert Shield and Desert Storm in 1990-91. The second Tornado echelon to arrive in Saudi Arabia was designated No. 617 (Composite) Squadron, being crewed both in the air and on the ground by No. 617 and other Marham-based squadrons. In command was Wing Commander Bob Iveson, Falklands War Harrier pilot and No. 617's boss. However, these squadrons did not fly their own Tornados (which were the early type, with lower-powered RB199 Mk 101 engines), and instead flew Mk 103-powered aircraft from Germany-based squadrons, later including Tornados with Phase 2 upgrade. By the time that No. 617 Squadron moved to Tabuk on 9 October, the first British ALARM anti-radar missiles were being delivered. In the low-level strike role, the Tornados were among the first into action, delivering JP233 sub-munitions against Iraqi airfields at night in the face of heavy ground defences. BL755 cluster bombs, laser-guided Paveway and ALARM weapons were also carried. Command of the Tabuk detachment was transferred to OC No. 16 Sqn before the war started, although 617 crews flew throughout the war with both this and the Muharraq detachment. Iveson returned to Tabuk as commander of a specialist flight (with Nos 13/617 Sqn crews) dedicated to operating the two prototype TIALD targeting pods.

Back to Lossiemouth

In 1992 No. 617's Tornados flew surveillance missions as part of Operation Jural, the monitoring of the UN-directed 'No-Fly' areas in southern Iraq. Later, they moved to Turkey to fly similar sorties in Operation Warden, to safeguard the Kurds in northern Iraq.

Following the collapse of the Communist bloc and the end of the Cold War, widespread reorganisation of the RAF included the move by No. 617 Squadron from Marham to Lossiemouth (from where No. 617 had flown the second and third attacks on the *Tirpitz* late in 1944). In 1994 the squadron assumed the maritime strike role, and was re-equipped with the Tornado GR.Mk 1B armed with BAe Sea Eagle radar-guided air-to-surface medium-range anti-shipping cruise missiles. **Francis K. Mason**

Above: **Donna Ewin** *was one of the five TIALD-carrying aircraft deployed part way through the Gulf War to provide laser designation for the Tornado force. No. 617 Sqn partnered No. 13 in providing the* **TIALD** *crews.*

One of the 'Dambusters' squadron's many claims to fame is that it was the first RAF unit to have a female combat pilot. Flt Lt Jo Salter is seen in her Tornado GR.Mk 1B in February 1995. In recent years the squadron has coded its aircraft with 'AJ-' prefixes in tribute to the dams crews.

Northrop F-89 Scorpion
Variant Briefing

Developed in the initial rush of jet-powered fighters in the late 1940s, the F-89 outlived most of its contemporaries, serving in the defence of the United States until 1969. During its career, the basic Scorpion airframe altered little, but its armament reflected the changing fashions of the day, progressing from guns, through rockets and missiles, to nuclear-armed rockets.

Although nowhere near as powerful as the nuclear Genie rocket, the most impressive of the Scorpion's weapons in terms of spectacle was the 2.75-in Mighty Mouse rocket. The weapons were launched at close range following a lead-collision intercept. All 104 rockets could be fired in 0.45 seconds, saturating an area of sky with devastating high explosives.

During the years when the Cold War was a volatile powder keg, the Northrop F-89 Scorpion defended North America. The F-89 was the bulky, ugly all-weather interceptor that stood ready to intercept nuclear-armed Soviet bombers heading toward American cities.

In 1958 USSR President Nikita S. Khruschev revealed the tenor of the times with a new approach to diplomacy: he taunted and terrified the world with wild claims about the ever-increasing megatonage of his country's hydrogen bombs. Khruschev's 1958 pledge to set off a 100-MT weapon still ranks as one of the most horrific threats ever made by a national leader. The test detonation yielded only one-third of what Khruschev had promised (but was still the most powerful bomb ever triggered), and the Soviet bomber force was always less numerous and less capable than American intelligence experts conjectured. Still, the threat of Tupolev Tu-4 'Bull' bombers sweeping down from the Arctic Circle to torch American cities was absolutely real. The men who supported, maintained and flew F-89s knew that at any hour of any day the klaxon might sound, and they would face the fight of their lives.

In the 1950s, school children were taught to take cover beneath their desks if a nuclear flash lit the sky. Civil Defense workers drew up plans to evacuate cities like New York and Washington. Every man who enlisted in the US armed forces was issued his own dosimeter, a tiny device worn on a chain around the neck – its sole purpose was to inform the wearer that he had absorbed a fatal dose of radiation. Plans to cushion a nuclear attack were unrealistic (in the early 1960s, they focused on family fallout shelters) but were taken seriously. So, too, was the defence of North America by interceptors like the Northrop F-89 Scorpion. In 1950-53, the USAF's Air Defense Command (ADC) had priority for weapons procurement over Far East Air Forces, even though the latter was waging an actual war in Korea.

A total of 1,052 Scorpions came off Northrop's Hawthorne, California production line in the growing Los Angeles area. This was a remarkable number for an aircraft viewed from the start as an interim step towards the 'Century Series' supersonic fighters of the late 1950s. More than 5,000 US Air Force and Air

The Scorpion was originally designed around a trainable four-gun nose armament, and the shape of the nose of the XF-89 prototype reflected that. The second prototype was 95 per cent completed to a similar standard before it was reworked to incorporate a fixed six-gun armament.

After their interceptor days were over, several Scorpions were used for drone launch and chase work in support of various US missile programmes. Here an EF-89B flies chase on a test round of the Northrop SM-62 Snark, a surface-to-surface strategic nuclear missile.

National Guard officers sat in the front and back seats of big, bulky Scorpions.

In its final incarnation, the F-89 Scorpion was a powerful and far-reaching flying truck. It would scramble aloft, intercept the bombers, and deposit its load of projectiles in their midst. For a time, the principal weapon of the F-89 was an unguided FFAR (folding-fin aircraft rocket), 104 of which could be sent careening wildly into an incoming bomber formation. Later, the F-89 carried the Genie air-to-air rocket which relied on an atomic warhead to blow up the attacking bombers. The US Air Force referred to both FFAR and Genie as 'projectiles' to distinguish them from 'missiles', which were guided; once launched from the F-89 and flying towards the bomber, neither FFAR nor Genie could be guided in any way by the Scorpion's pilot and radar operator .

In retrospect, we know that the bombers never came and the F-89 never saw combat. As a result, our view today of the unique, high-winged, high-tailed, twin-engined F-89 Scorpion becomes a look back at an era of peacetime military flying very different from today.

Mixed feelings

Some pilots and ROs swore by the Scorpion. Some swore at it. Although airmen often think that the aircraft they flew was the best flying machine ever to emerge from a factory, most did not think this about the F-89. It must be remembered that, unlike today – when a pilot may go from flight school to retirement 22 years later flying a single aircraft, such as the F-15 – those who flew the Scorpion lived in an age when airmen were qualified in several aircraft types at the same time, and flew as many as half a dozen aircraft types for sustained periods in the course of a career. Thus, almost any F-89 pilot or RO probably flew some other aircraft earlier, later, or longer than the ungainly Northrop interceptor, and would be more likely to give their loyalty to the other aircraft.

Our view of the Scorpion must also be influenced by the knowledge that flying in the 1950s was far more dangerous than it is today. At one point, at Nellis Air Force Base, Nevada where day-fighter gunnery training was conducted, USAF fighters were being lost in mishaps at the rate of one per week. About half of those crashes were fatal. In the first 30 months of the 1950s, the USAF suffered 1,833 major jet fighter accidents that killed 429 men. The F-89, which was bigger and more complex than other USAF fighters, also had the highest accident rate – 383 per 100,000 hours, contrasted to 0.5 per 100,000 for today's F-15.

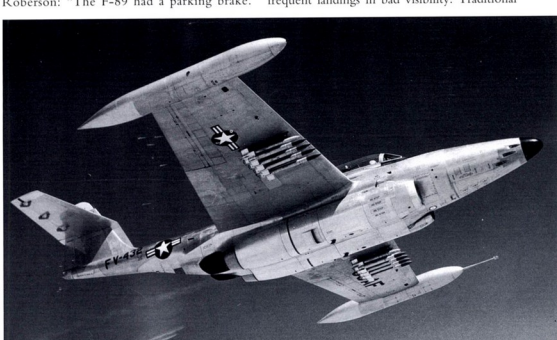
Every man who flew the F-89 also flew something else. So, even if the Scorpion had not been difficult to fly, costly to maintain, and subject to mishaps, it might not have emerged as the best-loved fighter of its era. Many agreed with pilot Captain Jim Cook, who was wedged into an F-89 cockpit after flying the nimble F-86 Sabre in combat in Korea. "If it's big enough that you can walk under the wing," said Cook, "it's not a fighter." The location of the wing was also useful for the queasy, as recalled by RO Captain Roger 'Roby' Roberson: "The F-89 had a parking brake.

The F-89B was the first version to enter service, although only a few were built. They initially went to the 83rd and 84th FIS at Hamilton AFB, California, followed by the 27th, 74th, 126th and 176th FIS. The latter two units handed over their aircraft to the 190th FIS, Idaho ANG (illustrated).

[From] what other aircraft can you stop during taxi-out, step out of the cockpit onto the wing, walk out to the wingtip, and puke over the tip tank? My pilot did this."

F-89 described

The Northrop F-89 Scorpion was a cantilever, mid-wing monoplane with a long, slim fuselage. An unswept laminar-flow wing was adopted to ensure good low-speed stability, important for an aircraft called upon to make frequent landings in bad visibility. Traditional



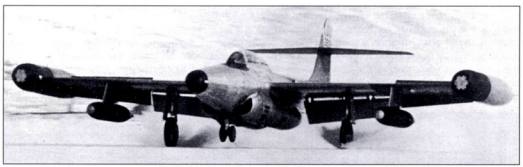
A little-known aspect of the F-89 was its air-to-ground capability, courtesy of bomb racks or HVAR rocket launchers, as seen here. The aircraft is an F-89A, one of a batch of eight aircraft procured primarily to speed operational evaluation prior to service entry.

Below: After transitioning to the F-89D in 1955, the 74th FIS at Thule made minor history when Captain Joseph A. Vaughan successfully completed the first landing by a jet on frozen sea. Of note are the double-slotted flaps and the fully deployed decelerons, which split above and below the wing to act as airbrakes.

Above: The F-89D rocket fighter was put into maximum rate production (around 25 per month) in 1955 to rapidly replace the less than ideal F-89C, and to allow the creation of new squadrons. One of these units was the 321st Fighter Interceptor Squadron, established at Paine AFB, Washington.

Left: The 437th FIS was established at Oxnard AFB, to the north of Los Angeles, in early 1956, flying the F-89D. Most Scorpion units devised colourful markings in line with ADC policy.

Right: From Alaska to Iceland the Scorpion maintained watch over the northern approaches to the USA. The 74th FIS at Presque Isle AFB had been one of the original F-89B squadrons, before switching to the F-89C in 1953. In August 1954 the 74th transferred to NEAC, and took its F-89Cs to Thule in Greenland to replace the 318th FIS F-94s. Here C models patrol over the berg-dotted waters around the Greenland coast.



ailerons and flaps were fitted to the wing trailing edge, and provisions were made for wingtip-mounted drop tanks. The aircraft was to be powered by a pair of Allison J35 afterburning turbojets, mounted one on either side of the belly of the fuselage just underneath the wings. The twin air intakes were mounted flush in front, each intake exactly in line with its engine nacelle. The pressurised cockpit seated the pilot and radar operator in tandem ejection seats underneath a large rearward-sliding bubble canopy. The horizontal tailplane was mounted halfway up the vertical tail, well out of the way of the engine exhaust. The nosegear was of a very short, twin-wheel design. The main retractable undercarriage had larger than usual wheels, giving the prototype a rather unusual appearance when sitting on the ground.

Since the Northrop aircraft was originally intended to be an all-weather fighter, an airborne interception radar was to be installed in the nose. The armament installation was to have been a quartet of 20-mm M24 cannons carried in a nose-mounted turret. Two different

The 57th FIS went to Keflavik in 1954 to assume the mantle of fighter squadron for the Iceland Defence Force. Unusually, this force was administered by MATS (Military Air Transport Service). The F-89C (illustrated) was kept in service by the 57th for longer than was ideal due to the difficulty in delivering new F-89Ds. The changeover was accomplished four aircraft at a time, with stops at Narsarssuak and Goose Bay.

turret designs were considered. One was a Martin design which allowed the guns to be stowed out of sight inside the nose when not needed; when needed, the guns would be elevated and moved forward into firing position. The Martin turret could rotate 360° and the guns could elevate 105°. The other turret design was a Northrop project, which was similar in concept to the Martin design but had only a 30° cone of fire. In the event, the nose turret plan did not materialise.

Pilot and radar observer (RO) sat in tandem in the big F-89. The twin engines hung in nacelles beneath the fuselage. With its vulnerability to foreign object damage (FOD) occasioned by its low-slung air intakes, the F-89 was sometimes disparagingly dubbed the 'Hoover Model 89'. Operational F-89s employed everything from 20-mm cannons to the nuclear-tipped Genie missile. The nose radar and fire-control system worked correctly only some of the time and were a constant challenge to maintenance personnel. Moreover, the Scorpion was literally a flying fuel tank: on mature variants, fuel was everywhere – behind the rocket armament, between the front seat and the radar, wedged back in the high bristling tail.

The sole YF-89D was used to thoroughly test the Mighty Mouse wing pods. The rocket section stood proud from the fuel-carrying section, allowing the blast gases to escape harmlessly through annular slots.

Defenders of freedom: a Scorpion crew pose beside an early production F-89H for the variant's public unveiling. The H entered service in March 1956 with the 445th FIS.

The Scorpion's unique appearance prompted RO Roberson to say that, "The T-tail looked like a stinger and the wing tanks looked like pincers" (in fact, the tail was closer to a cruciform shape). To pilot Major Marvin L. Randall, the Scorpion was "a leaky sneaky Nelly with a dripping, drooping belly," prone to vexing centre of gravity problems. Added Roberson, "The F-89 was a super ramp sweeper. Just look at where the intakes are. So we had engine screens [used for taxiing only from about mid-way through the Scorpion's career] to keep out rocks, nuts, bolts and beer cans."

The Scorpion's control surfaces included 'decelerons' (employed on all aircraft from the 33rd test flight of the XF-89), which were split, clamshell-style panels that could function as aileron, flap or speed brake. Jim Cook: "It was the only speed brake I ever used that could be deployed without requiring elevator trim. You could put those things out and you could descend 30,000 ft a minute."

According to legend, a structural problem with the F-89 wing was resolved by an unknown Northrop employee. An anonymous 'suggestion box' submission supposedly argued that the wings would be stronger if the builders would "drill 0.5-in holes all along the wing-roots, every 6 in." This was done with Scorpions from the F-89C model and the aircraft was able to pull 10 *g* without ripping off the wings. After a rigorous search, the employee who had made the suggestion was located. He was a janitor. How, he was asked, did he come up with this engineering solution? The janitor explained, "I've been putting out toilet paper for 30 years and I've never yet seen it tear where it was perforated."

Scorpion background

It was partly accident and partly the ability to overcome adversity that made the Scorpion a standard-bearer of the ADC. The Scorpion began, simply, as a night-fighter with a new kind of powerplant – the jet engine.

On 23 March 1945, the USAAF announced a competition for the successor to the Northrop P-61 Black Widow night-fighter. It was to be an all-weather fighter-bomber capable of guarding the northernmost frontiers of the United States, especially Alaska. Initially, a piston-engined design was considered, but in December 1945 the Army changed the requirement to stipulate that only a jet-powered aircraft would be acceptable. Bell, Convair, Douglas, Goodyear, Curtiss-Wright and Northrop submitted proposals.

The Convair entry was a radical, Delta-winged design which eventually emerged several years later as the F-102. The Douglas entry was a denavalised adaptation of the

54-261 was the first F-89H, seen here during tests of the Falcon pod. The missiles were normally housed within the pod behind closed doors, but were extended on rails for firing. The rocket motor of the GAR-1 burned for 1.2 seconds, giving a top speed of Mach 3.15 and a maximum effective range of about 7.5 miles (12.2 km).

XF3D-1 Skyknight carrier-based all-weather fighter. The Curtiss XP-87 Blackhawk was a large, four-jet aircraft carrying a pilot and radar operator seated side-by-side. Initially, the USAAF favoured the Curtiss design, if for no other reason than that the Curtiss-Wright company would probably close down if it did not land the contract. The service ordered two prototypes of the Curtiss design under the designation XP-87.

However, the USAAF also thought highly of the Northrop proposal, given the designation N-24 by the company. The service issued a development contract on 3 May 1946 and ordered two prototypes in December 1946.

Given the existing Cold War, US intelligence experts conceded that it was only a matter of time until the Soviet Union developed its own atomic bomb, a finding that was ignored by policy makers. The appearance of the Tupolev Tu-4 (a copy of the B-29) at the 1947 Tushino air display seemed to indicate that the USSR now had a means to deliver nuclear bombs to continental US targets.

Interim interceptor

There were no all-weather jet-powered interceptors yet available to counter the USSR threat, so it was necessary to get an aircraft to the squadrons immediately. Since neither the Curtiss-Wright nor the Northrop designs would be available in quantity for several more years, the USAF asked Lockheed in March 1948 whether the TF-80C two-seat trainer could be adapted as an all-weather fighter, with first deliveries to operational squadrons being made before the end of 1949. Lockheed quickly came up with a design that eventually emerged as the F-94 Starfire.

By the end of its career, the F-89 Scorpion had equipped 36 active Air Force units and 17 Air National Guard squadrons. Although 1,052 Scorpions were manufactured, their recurring problems kept the combat fleet to a smaller size than was ever planned. On 30 June 1958, the Air Defense Command had 342 F-89s in inventory with 231 considered combat ready, the command's highest number of combat-ready Scorpions. **Robert F. Dorr**

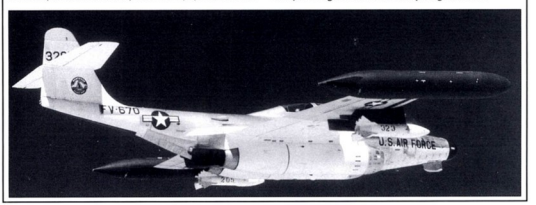
Above: In ANG service the F-89J enjoyed a lengthy career. Minnesota's 179th FIS was the first to receive the Genie-equipped fighter, in July 1959. It converted to the F-102 in November 1966, one of five ANG units to give up its F-89s that year.

Right: Changing of the guard: an F-89J of the 116th FIS, Washington ANG, stands silent as the first of the unit's new Delta Daggers (a two-seat TF-102A) arrives at Geiger Field on 29 June 1965. In addition to the squadron's badge, the Scorpion wears Genie markings, signifying inert launches.

Operation Plumb Bob

After some six months of operational service, it was decided in July 1957 to test the capability of the MB-1 Genie nuclear rocket for real, as part of a series of nuclear tests known as Operation Plumb Bob. Three 84th FIS F-89Js were assigned to the tests, which flew from Indian Springs, Nevada. On 19 July, Captains Eric Hutchison (pilot) and Alfred 'Cliff' Barbee (RO) launched a single Genie (Test Shot John) from 53-2670 over the Yucca Flats test area. The missile was fired at 14,000 ft (4267 m), and the detonation resulted in a ball of fire ½-mile (0.8 km) in diameter, this then being taken as the recognised lethal zone for the weapon. Air Force personnel were situated at Ground Zero to prove that the weapon could be safely used over populated areas.

Above and below: Two views show 53-2670, the only F-89 credited with a live Genie launch, which was with the 84th FIS at the time. Above it is carrying Falcons, while below it has Genies. The fin badge reads 'Northrop Flight Test'.



F-89 Scorpion Variants

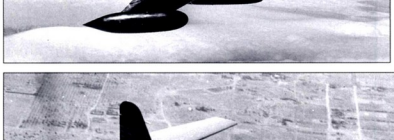
The F-89 Scorpion had to overcome obstacles and took a long time to reach maturity, but it served the USAF in half-a-dozen production versions and was evaluated in many other configurations. There were numerous proposals for Scorpions that were never built, some of which are described below. Others, such as the F-89 armed with GAR-8 (later AIM-9) Sidewinder infra-red air-to-air missiles, never progressed much farther than the discussion stage. The entries that follow describe every variant of the Scorpion that was built and most that were seriously contemplated, but discarded. Test and trials aircraft are described separately from the main production variants.

XF-89 (XP-89)

A cloak of sinister, night-fighter gloss black, so apt for the Scorpion name, enshrouded the prototype XP-89 when it was rolled out of the Northrop factory in Hawthorne in June 1949. The new Northrop fighter had barely got through the doors before its designation changed: on 11 June 1948, the US Air Force dropped the 'P' for pursuit designation it had used for a quarter of a century and adopted 'F' for fighter. This high-winged, twin-engined, blunt-nosed aircraft became the XF-89. Following a taxi and brake tests at Northrop Field, the XF-89 was disassembled and trucked to Muroc Dry Lake (later named Edwards AFB).

The XF-89 made its first flight on 16 August 1948 at Muroc, piloted by Northrop test pilot Fred Bretcher. The XF-89 was powered by a pair of Allison J35-A-9/-15 engines of 4000-lb (17.79-kN) static thrust each. Neither the Martin nor the Northrop turrets were ready, so the prototype carried no armament. At roll-out, the XF-89 did not carry its jettisonable 600-US gal (2270-litre) wingtip tanks. With a fuselage length of 50 ft 5 in (15.42 m), this black test ship was 3 ft (0.92 m) shorter than the F-89A model and almost 4 ft (1.22 m) shorter than the eventual production F-89B. The prototype was slightly heavier than production Scorpions that followed – when empty, it weighed 25,864 lb (11731 kg), about 1,000 lb (454 kg) more than an F-89B.

Fitting the wingtip fuel tanks nearly doubled the XF-89's fuel capacity. The aircraft was lost after 102 flights.



Flight test results were generally positive, but the aircraft proved to be seriously underpowered. Conventional ailerons were fitted for the first 32 flights, but on 1 February 1949 a new series of trials began with Northrop-invented 'decelerons'; these split surfaces could be operated in one piece as a conventional aileron but could also be opened up to serve as an airbrake. This feature was made standard on all subsequent F-89s.

Even though flight test crews were enthusiastic about the XF-89, the USAF ordered a fly-off between the XF-89, the Curtiss XF-87, and the Navy's Douglas XF3D-1 Skyknight. The Curtiss XF-87 with its side-by-side seating arrangement was judged to have the best cockpit arrangement, with the XF3D-1 coming in second – which is interesting in retrospect, for most two-seat warplanes since then have had tandem seating. The tandem seating arrangement in the XF-89, in any event, was found to make communication between pilot and radar operator difficult. The XF3D-1 was the clear winner when ease of maintenance was evaluated, with the XP-87 coming in second. However, the evaluation team judged that the XF-89 was the superior fighter and had the best development potential.

In the wake of this judgement, on 10 October 1948 the USAF officially cancelled the Curtiss XF-87 project. The failure of the XF-87 to win any production orders was the end of the line for the Aeroplane Division of Curtiss-Wright. Shortly thereafter, the Aeroplane Division declared bankruptcy, sold its assets to North American, and closed its doors forever.

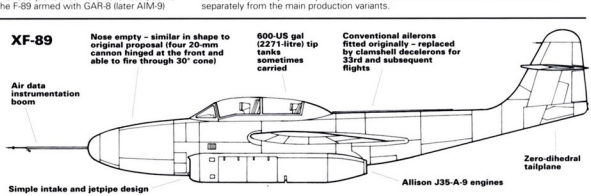
Even though the Douglas XF3D-1 did not win a USAF order, it received orders from the US Navy and the US Marine Corps, and went on to serve as both a land-based and carrier-based interceptor fighter for many years. In the Korean War, the F3D scored more aerial victories than any other naval jet, including the better-known Grumman F9F Panther.

The XF-89 returned to flight test on 15 October 1949. After a few more months of contribution to Scorpion development work, the XF-89 crashed on its 102nd flight on 22 February 1950 near Hawthorne. Air Force officials were watching when the right horizontal stabiliser peeled off as pilot Charles Tucker and flight engineer Arthur Turton were making a high-speed low pass. The aircraft tore itself apart and threw Tucker clear, and he parachuted to safety, but Turton died in the mishap. The cause of the accident was found to be a high-frequency, low-amplitude flutter of both the vertical and horizontal stabilisers. While experts examined the Scorpion's tail design, the USAF temporarily curtailed factory work on those F-89s already under construction. The Scorpion was always very much an 'also ran' even when there were no problems – the USAF was already planning supersonic interceptors, to come with a later generation – and trouble was exactly what the Scorpion programme did not need.

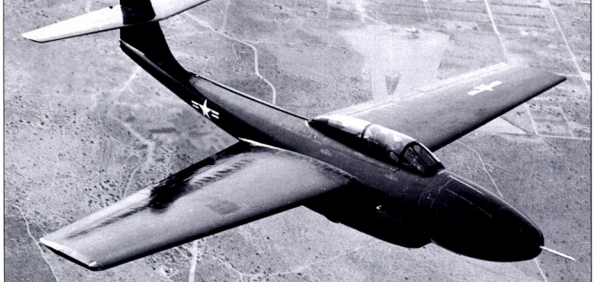
Serial: 46-678 (1)

The Scorpion's wing was one of the thinnest ever fitted at the time of its first flight, giving a high cruising Mach number.

XF-89


Nose empty – similar in shape to original proposal (four 20-mm cannon hinged at the front and able to fire through 30° cone)
600-US gal (2271-litre) tip tanks sometimes carried
Conventional ailerons fitted originally – replaced by clamshell decelerons for 33rd and subsequent flights
Air data instrumentation boom
Zero-dihedral tailplane
Simple intake and jetpipe design
Allison J35-A-9 engines

The XF-89 takes off from Muroc on an early flight. The conventional ailerons used for early flight testing also drooped for extra lift, operating in conjunction with the flaps.



YF-89A

This aircraft was 95 per cent complete as the second XF-89 when the USAF ordered it modified to a configuration representative of the planned production aircraft. This ship was completed in natural metal rather than the night-fighter black of its predecessor. The YF-89A, or manufacturer's Model N-49 (46-679), was a one-off developmental aircraft. Conceived as a companion to the Scorpion prototype, it differed significantly after changes were made on the drawing board and on the factory line. Although this aircraft is often referred to by other designations, it was never known as anything but the YF-89A after this nomenclature was applied on 4 January 1949.

The XF-89A dispensed with several features of its predecessor, including a fin-mounted pitot tube and a nose-mounted instrument probe. Its fuselage length increased by 3 ft (0.92 m) to 53 ft 5.2 in (16.29 m) due to a longer, slimmer nose configuration, consisting of the Hughes-built nose with six 20-mm T-31 (M24) cannons armed with 200 rounds per gun. The nose also contained an AN/ARC-33 radar coupled to a Hughes E-1 fire control system. The XF-89A introduced 300-US gal (1135-litre) wingtip tanks. Powerplant for the YF-89A was initially two 4,000-lb (17.79-kN) static thrust Allison J35-GE-3 turbojets. The XF-89A's engines were housed in longer, slimmer nacelles than those of the prototype and were equipped with exhaust deflector shields. The powerplant changed as the Scorpion programme underwent alterations.

In January 1949, President Harry Truman authorised the Air Force to make an initial purchase of 48 F-89As. In March 1949, the name 'Scorpion' was officially applied. The name was suggested by ground crews at Muroc who thought that the parked aircraft, with its upward-curving rear fuselage and its high tail, bore a strong resemblance to the dangerous arachnid with the deadly stinger in its tail.

The XF-89A made its maiden flight on 15 November 1949. Since the USAF wanted the Scorpion in service right away, production of the F-89A got underway immediately. This commitment to production proved premature. The 22 February 1950 crash of the black XF-89 prototype and the discovery of tail flutter problems loomed menacingly over the Scorpion programme. One immediate effect was that the XF-89A was grounded.

Northrop's engineering team modified the YF-89A extensively as a result of the grounding. The engines became Allison J35-A-21s, rated at 5,200 lb (23.12 kN) static thrust dry and 6,800 lb (20.44 kN) static thrust with afterburners. The team redesigned the air intakes to include external boundary layer bleed ramps and added auxiliary pop-in doors to the nacelle sides to allow additional air to be supplied to the engine during ground run-ups. The engineers believed that pulsating exhaust gases from the engine had been responsible for the tail flutter problems that had wrecked the XF-89, so they redesigned the engine exhaust area by adding deflector plates to the fuselage to direct the exhaust away from the tail. They moved the pitot tube from the vertical tail to the nose. The jettisonable 300 US-gal wingtip tanks of the XF-89 were replaced by permanently attached, more streamlined tanks of the same capacity.

The heavily-modified YF-89A resumed flying on 27 June 1950 and the Scorpion flight test programme was continued, but with a bumpy road ahead.

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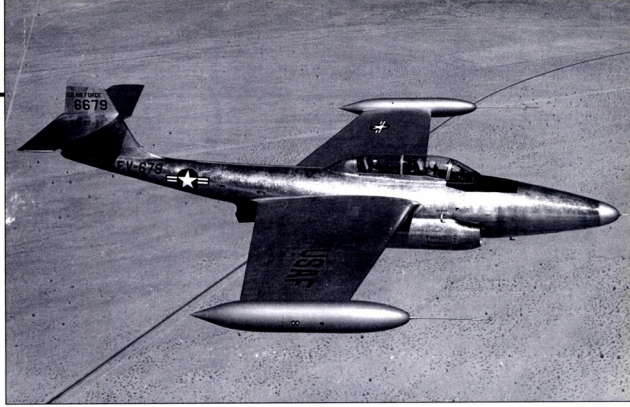
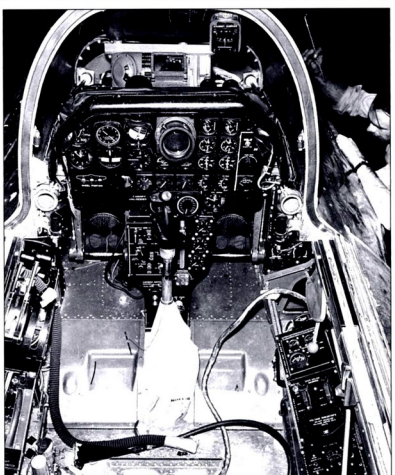
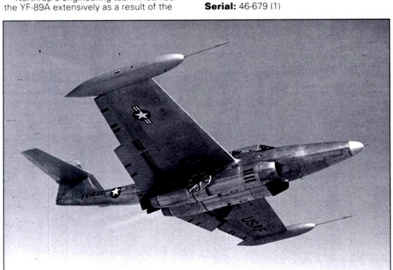


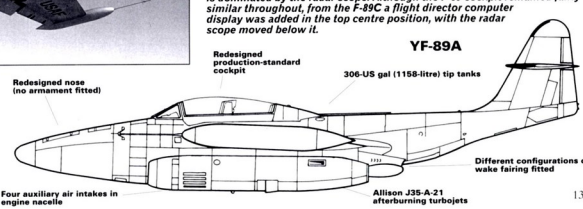
Above: Compared to the XF-89, the YF-89A was a major redesign, with a new nose, new tip tanks and revised exhaust for the more powerful engines.



The cockpit of the YF-89A was fairly representative of the first F-89A/B production aircraft. This is the pilot's station, in which the instrument panel is dominated by the radar scope. Although the F-89 cockpit remained fairly similar throughout, from the F-89C a flight director computer display was added in the top centre position, with the radar scope moved below it.



Above: Lifting off from Edwards AFB (as Muroc Dry Lake became), the YF-89A cleans up its single mainwheels. The high-lift arrangement consisted of an inboard double-slotted flap with an outboard surface which acted as flap, aileron or speedbrake.


YF-89A
Redesigned production-standard cockpit
306-US gal (1158-litre) tip tanks
Redesigned nose (no armament fitted)
Different configurations of jet wake fairing fitted
Four auxiliary air intakes in engine nacelle
Allison J35-A-21 afterburning turbojets

F-89A

The F-89A, or company model N-35 (eight built), was nominally the first production version of the Scorpion although it was, in reality, far from being an operational aircraft ready for assignment to a squadron that might see combat.

The engines of the F-89A were originally a pair of Allison J35-A-21s, which, in the autumn of 1950, were regularly throwing their turbine blades. After this rash of engine failures on early F-89As, these aircraft underwent the same modification as the YF-89A test ship and were re-engined with Allison J35-A-21A turbojets rated at 5,100 lb (22.68 kN) static thrust dry and 6,800 lb (20.44 kN) static thrust with afterburning. These engines had an engine oil scavenging system and new afterburner eyelids, which gave smoother afterburner control.

The F-89A was armed with six 20-mm T-31 (M24) cannons with 200 rounds per gun. It used an A1-CM gunsight, and AN/APG-33 nose radar was fitted in the nose. This version boasted underwing pylons to carry 16 rockets or up to 3,200 lb (1450 kg) of bombs.

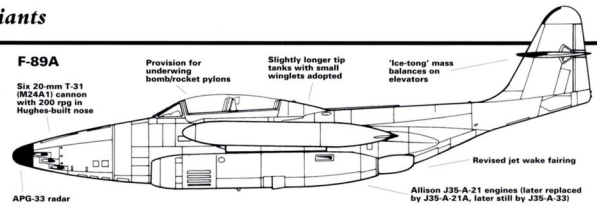
The F-89A Scorpion took to the sky for the first time on 25 September 1950 with Northrop test pilot John Quinn at the controls. At the time when the Air Force accepted its first F-89A, three months into the Korean War, many of the top brass wanted to cancel the programme because of the tail flutter problems that had caused the prototype to crash. (The USAF was already developing the F-102 as its principal interceptor and had decided that, in the interim, the F-86D Sabre and F-94C Starfire interceptors would enjoy priority over the Scorpion.) In an effort to counter this, the F-89A and some subsequent aircraft emerged from the factory with external mass balance horns, known as ice tongs, which resulted from an investigation into stability problems with the XF-89. The external mass balances on the early F-89As were eventually replaced by elevators with internal mass balance which were fitted retroactively after being developed for the F-89C.

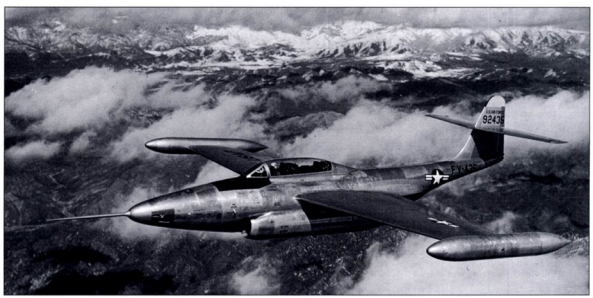
When the XF-89 crashed, three F-89As were nearing completion. Air Force officers decided that these three machines, plus the YF-89A, would make up the test force used to wring out problems with the Scorpion. The USAF accepted its first production F-89A on 28 September 1950, three days after its first flight, followed by the second and third a few weeks later.

The experts corrected the Scorpion's troublesome and potentially fatal tail flutter problem with a series of external mass balance horns attached to the hinge area of the horizontal stabiliser/elevator. They changed the configuration of the underfuselage exhaust deflector fairings and tried a number of different fairing shapes until a final design was adopted. The lines of the rear fuselage behind the jet pipes were altered to overcome some of the excessive turbulence that the YF-89A had encountered at high speeds. With these changes, the tail flutter problem was finally believed to be cured, and in January 1951 production of the F-89A resumed.

Northrop built just eight F-89As. The initial number of F-89As had been 48, in a contract that dated to 14 July 1949, although Air Force documents referred to requirements for 64, then 116. In addition to the eight ships, Northrop completed three (49-2439/2441) that were modified to become the first F-89Bs. Subsequent aircraft in the original production order for 48 embodied enough changes that they were designated F-89B or F-89C.

Serials: 49-2431/2438 (8)


F-89A
Six 20-mm T-31 (M24A1) cannon with 200 rpg in Hughes-built nose
Provision for underwing bomb/rocket pylons
Slightly longer tip tanks with small winglets adopted
'Ice-tong' mass balances on elevators
Revised jet wake fairing
Allison J35-A-21 engines (later replaced by J35-A-21A, later still by J35-A-33)
APG-33 radar



Carrying an instrumentation boom, this is the fifth F-89A. All of the eight aircraft were used for trials purposes.

Above: Six external 'ice-tong' mass balances, and one internal, were added to the elevator as a temporary fix for buffet problems. This was tested on the YF-89A and was applied to early production aircraft.

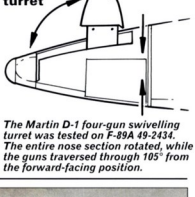
Above left: Clearly visible on the No. 5 F-89A are the 20-mm cannon barrels.

Left: F-89As were used to test the Scorpion's ground attack capability. No. 2 is seen here firing 5-in (12.7-cm) HVARs (High-Velocity Aircraft Rockets) from underwing launch rails. The original requirement called for up to 26 of these weapons to be carried.

F-89A/B test aircraft

Seen in May 1950, this aircraft was used for the AST (accelerated service test) programme before being passed to Allison as a JF-89A for further engine trials.

Several F-89As were converted for test purposes. One aircraft (49-2433), without nose cannon, was used to test air-to-ground capability at Eglin AFB, Florida. One (49-2434) was employed in a gunnery experiment with the installation of the Martin D-1 nose turret that was contemplated, but not adopted, for all F-89s. Another (49-2438) was used by Allison for experimental work under the designation JF-89A. Several obsolete F-89As were later modified into radio-controlled target planes under the designation DF-89A. There were also DF-89B and EF-89B (E for 'Exempt') conversions of the F-89B, some being used to chase and control Snark missiles during tests.



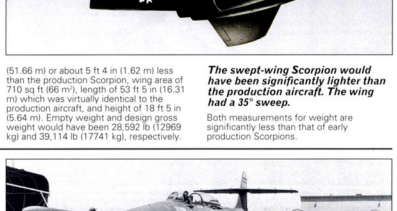
The Martin D-1 four-gun swivelling turret was tested on F-89A 49-2434. The entire nose section rotated, while the guns traversed through 105° from the forward-facing position.

'Swept-wing F-89'

Early in the Scorpion programme, while the F-89B production ship was taking shape (next entry), Northrop explored a 'swept-wing F-89' that was slightly smaller and lighter than the aircraft which eventually reached squadron service. Never given a designation by Northrop or the USAF, the 'swept-wing F-89' was a proposal of the late 1940s and early 1950s based on the F-89A. Northrop engineers regarded the swept wing as a modification of the existing wing, swept back at 35° on the leading edge. It was not an original idea to suggest a swept-wing version of a straight-wing fighter; combat experience in Korea's 'MiG Alley' had demonstrated that straight-wing jet fighters would never again dominate the air-to-air arena. There were many other examples, including the Grumman F9F-6 Cougar based on the F9F-5 Panther, and the Republic F-84F Thunderstreak based on the F-84E Thunderjet.

The 'swept-wing F-89' would have had a horizontal stabiliser 25 per cent smaller than that of the production Scorpion. Powerplant was to have been two Allison 450E-1 turbojet engines each producing 10,000 lb (44.48 kN) thrust, or 15,000 lb (66.73 kN) with afterburning. With these engines, the Scorpion would have been able to climb to 35,000 ft (10670 m) in seven minutes. The 'swept-wing F-89' would have had a maximum speed of 731 mph (1176 km/h) at sea level and 661 mph (1063 km/h) at its impressive combat ceiling of 65,000 ft (19800 m).

Armament was to be 20-mm cannon or 2.75-in FFARs located around the nose radar in a configuration like that of the future Lockheed F-94C Starfire. Other characteristics of the 'swept-wing F-89' would have included wing span of 51 ft 8 in



(51.66 m) or about 5 ft 4 in (1.62 m) less than the production Scorpion, wing area of 710 sq ft (66 m²), length of 53 ft 5 in (16.31 m) which was virtually identical to the production aircraft, and height of 18 ft 5 in (5.64 m). Empty weight and design gross weight would have been 28,592 lb (12969 kg) and 39,114 lb (17741 kg), respectively.

The swept-wing Scorpion would have been significantly lighter than the production aircraft. The wing had a 35° sweep.

Both measurements for weight are significantly less than that of early production Scorpions.

F-89B

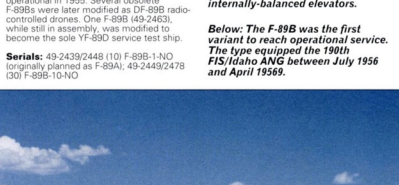
The F-89B, like the 'A' model known to its builder as the Model N-35 (40 built), differed from the F-89A in having improved cockpit lighting, an ILS (instrument landing system), a Sperry zero-reader (combining the functions of altimeter, artificial horizon, directional gyro and magnetic compass), a Lear F-5 autopilot, and a fan marker beacon receiver. The F-89B retained the armament and radar of the 'A' model.

Initially, the F-89B retained the external mass balance horns found on 'A' models that were used to overcome severe flutter caused by the jet exhaust. Gradually, the USAF refitted B models with elevators having internal mass balance after this feature had been developed for the F-89C. As with the YF-89A and F-89As, following a rash of engine failures the manufacturer re-engined the B with J35-A-21A turbojets rated at 5,100 lb (22.68 kN) static thrust and 6,800 lb (20.44 kN) thrust with afterburning.

The USAF took delivery of its first F-89B in February 1951. The B model entered service in June 1951 with the 84th FIS, 78th FIG at Hamilton AFB, north of San Francisco. Three other squadrons had received F-89Bs by early 1952: the 27th FIS at AFB, New York, the 74th FIS at Presque Isle, Maine, and the 174th FIS at Truax Field in Madison, Wisconsin.

The USAF may have rushed too many F-89Bs into operation too quickly. Trained maintenance men were few and far between, and spare parts were not yet readily available. ADC did not even have enough pilots and radar operators. Worse, the Hughes E-1 fire control system was as yet unproved, trouble-prone, and difficult to keep in proper operation. During its first year of service, the F-89B had the lowest 'aircraft in commission rate' and the worst safety record of any operational fighter. What is more, Scorpions were crashing too often. The USAF grounded the F-89 fleet on 22 September 1952 and the Northrop interceptors remained in non-flying status for nearly seven months (see F-89C entry).

The USAF service life of the F-89B was brief. By 1954, all F-89Bs had been



transferred to the Air National Guard. The 126th FIS and 176th FIS, Wisconsin ANG, were the first Guard units to be fully operational in 1955. Several obsolete F-89Bs were later modified as DF-89B radio-controlled drones. One F-89B (49-2463), while still in assembly, was modified to become the sole YF-89D service test ship.

Serials: 49-2439/2448 (10) F-89B-1-NO (originally planned as F-89A); 49-2449/2478 (30) F-89B-10-NO

Above: The F-89Bs were initially completed with 'ice-tong' mass balances, but were retrofitted with internally-balanced elevators.

Below: The F-89B was the first variant to reach operational service. The type equipped the 190th FIS/Idaho ANG between July 1956 and April 19569.

F-89C

The F-89C, or Northrop Model N-35 (164 built), was the first major production Scorpion. It incorporated changes demanded by the Air Force to make the Scorpion a fully operational and safe aircraft. The F-89C retained the dimensions of the F-89A and B, namely wing span of 56 ft (17.06 m), length 53 ft 6 in (16.30 m), height 17 ft 8 in (5.18 m).

Beneath the skin, the F-89C boasted many internal changes, including a fuel purging system which helped alleviate the danger of fuel vapour explosions, plus upgraded cockpit air conditioning and pressurisation system. The wingtip fuel tanks had dump valves which allowed them to be emptied in flight. An alcohol de-icer tank was added on one of the underwing racks; the latter theoretically were capable of carrying bombs, thereby conferring air-to-ground capability. A Lear vertical gyro was added to provide artificial horizon information to the autopilot.

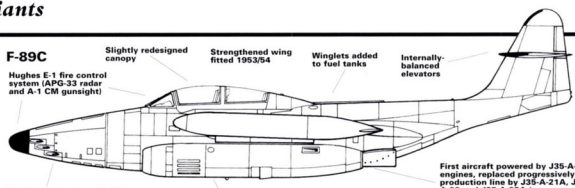
It was easier to see other changes, which were also distinctive identification features of the F-89C. There was a minor change to the canopy shape. Some sources claim that the first 40 F-89Cs were equipped with the external mass balance horns on the horizontal stabiliser/elevator, but this is erroneous; from the beginning, the F-89C had a strengthened horizontal tail with internal mass balances, and a cleaner look.

Even though the Scorpion was rapidly entering squadron service throughout 1952-53, it continued to be plagued by engine failures. The initial production blocks (1 through 20) of the F-89C were powered by a pair of J35-A-21 engines. In service, these engines were unreliable and subject to frequent failures. The problem was solved by retrofitting these early F-89Cs with the improved and more reliable J35-A-21A engine.

Beginning with the F-89C-25-NO, the engine was changed yet again to the Allison J35-A-33 jet rated at 5,400 lb (24.02 kN) static thrust dry and 7,400 lb (32.91 kN) with afterburner. Finally, production blocks -35 and -40 were fitted with the Allison J35-A-33A, rated at 5,600 lb (24.91 kN) static thrust dry and 7,400 lb (32.91 kN) static thrust with afterburner. The -33A engine not only had more power, it also had a redesigned inlet, de-icing equipment, inlet guide vanes, and redesigned forward engine mounts. The F-89's engines, being mounted quite low on the fuselage, had a tendency to scoop runway debris into their intakes. To cure this problem, the USAF added retractable inlet screens to the -33A engine.

Other problems with the Scorpion turned out to be much more serious. During 1952, several F-89Cs crashed due to wing

Below: The F-89C was the definitive gunfighter, entering service in numbers despite the fleet-wide grounding in late 1952.


F-89C
Slightly redesigned canopy
Strengthened wing fitted 1953/54
Winglets added to fuel tanks
Internally-balanced elevators
Hughes E-1 fire control system (APG-33 radar and A-1 CM gunsight)
Six 20-mm cannon with 200 rpg as standard
Bulge for fuel-purging system on starboard engine nacelle
First aircraft powered by J35-A-21 engines, replaced progressively on production line by J35-A-21A, J35-A-33 and J35-A-33A (many subsequently retrofitted with J35-A-47)

An F-89C takes off in full afterburner. The lack of wingtip fins identifies this as being prior to the grounding and rewinging programme.

structural failures, and no fewer than six aircraft were lost in the spring and early summer of that year. A spectacular crash occurred in front of thousands of spectators at the International Aviation Exposition at Detroit. The USAF grounded the entire Scorpion fleet.

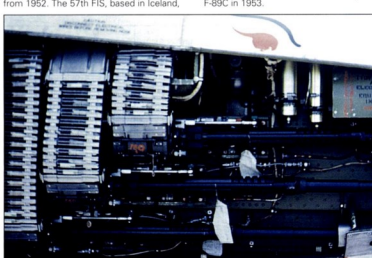
After exhaustive flight tests, experts traced the problem to a previously unknown effect: aero-elasticity. This caused the wing to twist at the tip during high-g manoeuvres, exerting excessive strain on the wing attachment points and causing them to fail. The large wingtip fuel tanks were found to be a significant factor in exerting this twisting moment. One hundred and ninety-four F-89As, Bs and Cs were shipped back to Northrop where they were fitted with stronger wings with forged steel attachment points. At the same time, a small fin was added to the outboard rear of each wingtip tank, which reduced the aerodynamic forces on the tank that caused it to flex and twist during manoeuvring.

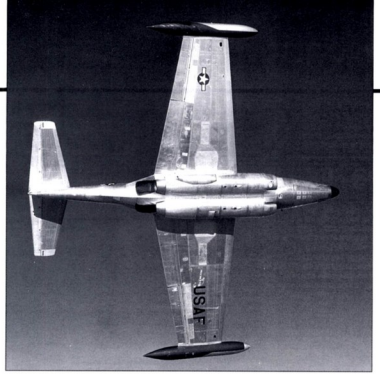
Fourteen months passed before the F-89C fleet was retrofitted with the new, stronger wing, and it was not until 1954 that the Scorpion force reached its intended level. As quickly as the F-89Cs could be modified, they were flown directly to their operational units.

The first F-89C flew on 18 September 1951. In January 1952, the 74th Fighter Interceptor Squadron at Presque Isle AFB, Maine, already a user of the B model, was declared operational with the F-89C. Other units followed. Winterised F-89Cs went to Elmendorf AFB, Alaska and Harmon AFB, Newfoundland, thereby beginning a long tenure by the Scorpion in northern climes. With its modified wing and improved engines, the Scorpion became one of the safest and most reliable combat aircraft in the USAF inventory. The 74th FIS, following its transfer to Thule, Greenland in August 1954, completed a full year of service with the type without an accident of any kind.

Right: The six 20-mm cannon were staggered to accommodate the ammunition feeds and breeches in the nose.

The F-89C served with the 27th, 74th and 433rd Fighter Interceptor Squadrons from 1952. The 57th FIS, based in Iceland, the 65th and 66th FIS based in Alaska, and the Stateside 438th FIS took delivery of the F-89C in 1953.





Left: An underview of an early F-89C shows the large bulged fairing for the fuel purging system. This used engine bleed air and fuel to create an inert gas to purge the fuel system. A tip tank fuel dump system was also installed.

Above: F-89Cs were assigned to the Air National Guard from 1955, the three squadrons of the Michigan ANG (171st FIS illustrated) being the first recipients. They had been reworked prior to delivery.

Below: After three ADC units had been equipped with the F-89C, deliveries began to Alaskan Air Command's 10th Air Division at Elmendorf AFB. The aircraft had been winterised at Ogden ALC.

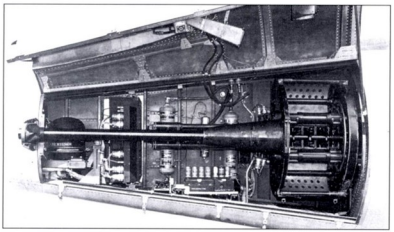
The F-89C was phased out of active USAF service during 1954, when later Scorpion models became available. The aircraft were then transferred to the Air National Guard, equipping seven units in northern states. F-89Cs from three squadrons of the Michigan ANG became the first Scorpions to be turned over for final disposition to the USAF's 'boneyard' at Davis-Monthan AFB, Arizona, in 1958. Other ANG squadrons operated the F-89C until well into the 1960s. One F-89C (50-762) was modified to become a YF-89E testbed with a pair of 9,500-lb (42.26-kN) static thrust YJ71-A-3 engines.

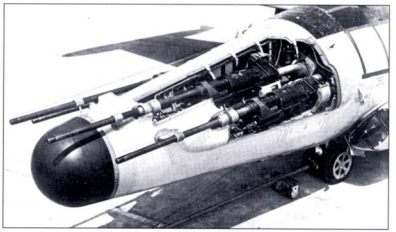
Serials: 50-741/744 (4) F-89C-1-NO; 50-745/759 (15) F-89C-5-NO; 50-760/774 (15) F-89C-10-NO; 50-775/789 (15) F-89C-15-NO; 50-790/804 (15) F-89C-20-NO; 51-5757/5771 (15) F-89C-25-NO; 51-5772/5801 (30) F-89C-30-NO; 51-5802/5836 (35) F-89C-35-NO; 51-5837/5856 (20) F-89C-40-NO
Total F-89Cs: 164

F-89C Gun-Val

As part of Project Gun-Val, the USAF modified one F-89C (51-5795) to carry two T110E3 'rocket gun' launchers in its nose. Each of these rifled barrels was fed by a 25-rocket magazine that housed 2.75-in FFARs. Another Gun-Val aircraft (51-5766) was fitted with four 30-mm Oerlikon 302RK cannon in the nose with 100 rpg.

The four Oerlikon 302RK cannon had long protruding barrels. Each gun had 100 rounds, each of which weighed 1.85 lb (0.84 kg).





Above, right and below: The T-110E3 rocket gun had 25 T-131 2.75-in (7-cm) spin-stabilised rocket rounds. A charge fired the rocket, which then used its motor for further thrust.

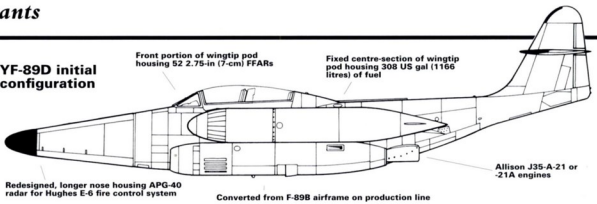
F-89 Scorpion Variants

YF-89D

An F-89B Scorpion (49-2463) was pulled from the production line to become the sole YF-89D service-test prototype, introducing all-rocket armament. This was the first in the series to have wingtip tanks that carried both rockets and fuel. The YF-89D nose was recontoured to house the Hughes E-6 fire control system with a larger, flatter radome. A 260-US gal (985-litre) fuel tank occupied the nose area used for a gun on previous models. The YF-89D was somewhat larger than previous Scorpions, with a wing span of 57 ft 9.4 in (17.60 m), length 53 ft 10 in (16.41 m) and height 17 ft 5.6 (5.33 m). The YF-89D first flew on 23 October 1951, piloted by Northrop's Ray Tenhoff. It was employed in developmental work for two years before being lost in a mishap on 20 October 1953.

Serial: 49-2463 (1 – converted)

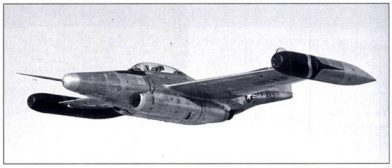
YF-89D initial configuration


Front portion of wingtip pod housing 52 2.75-in (7-cm) FFARs
Fixed centre-section of wingtip pod housing 308 US gal (1166 litres) of fuel
Redesigned, longer nose housing APG-40 radar for Hughes E-6 fire control system
Allison J35-A-21 or -21A engines
Converted from F-89B airframe on production line

Below: The YF-89D was painted with large Dayglo areas for maximum conspicuity during rocket-firing trials. Here the aircraft carries the revised nose profile adopted as standard for production F-89Ds.

Above: In its original form the YF-89D had a more slender nose than that fitted later. The side of the nose incorporated panels for rapid access to the new radar.

Below: During YF-89D trials a more rounded nose shape was adopted, while the original frangible nosecones for the rocket pods were discarded.



F-89D

The major production version of the Scorpion was the F-89D, or builder's Model N-68 (682 built). With the F-89D, cannons were discarded in favour of all-rocket armament. Rocket launching pods were housed in the forward edges of the wingtip fuel tanks. These tanks were longer and had a larger diameter than the 300 US-gal tanks carried by the F-89C. The forward third of each tank contained a series of launch tubes for 52 2.75-in FFARs. The rockets were known as 'Mighty Mouse', after the roguish rodent of Saturday cinema cartoons ("Here I come to save the day"). These rockets were unguided and had an effective range of about 6,000 ft (1830 m), and were equipped with high-explosive warheads. The rear two-thirds of the tank was taken up by 308 US gal (1165 litres) of fuel which, perhaps surprisingly, was 100 per cent safe from the fiery heat of rocket exhausts.

The all-projectile armament (the rockets were not 'missiles' as the USAF used the word, because they were unguided – "wildly so" in the words of one pilot) reflected US military thinking in the late 1940s and early 1950s, and was probably appropriate for the Scorpion's primary task of intercepting large, slow-moving bombers. On the F-89D, the pilot could select several options when firing. The rockets could be fired at once, all 104 leaving the tubes in only four-tenths of a second. When salvoed, the rockets could blanket an area the size of a (North American) football field, enveloping the target in a pattern reminiscent of a shotgun blast. One hit was deemed sufficient to bring down a bomber. The pilot

The F-89D followed the contemporary trend to become an all-rocket fighter. Additional fuel was housed in the nose.

Fuel
The F-89D had considerably greater fuel capacity than the C, being able to carry drop tanks under the wings and some fuel in the wingtip pods. Additional capacity was provided by a tank in the nose which filled a space left by the removal of the cannon, and which also negated the need for 600 lb (272 kg) of lead ballast carried by the C.

Wing surfaces
The F-89 had an advanced wing surface configuration for its day. Powerful double-slotted flaps occupied 58 per cent of the wing trailing edge, while the decelerons occupied the remaining 42 per cent. These drooped at low speed for extra lift, acted as conventional ailerons for roll control, or split above and below the wing to act as airbrakes.

F-89 in NEAC service
Northeast Air Command received its first Scorpions in early 1954, when the 61st FIS transitioned to F-89Cs at Harmon AFB in Newfoundland. In August the 74th FIS moved from Presque Isle (ADC) to Thule (NEAC) in Greenland, again with F-89Cs. The 59th FIS was the first NEAC F-89D squadron, receiving its aircraft at Goose Bay in late 1954. In 1957 the command was deactivated, the three F-89D units falling under the ADC umbrella.

Rear cockpit
The radar observer was provided with a small vertical instrument panel, next to the antenna for the radio loop compass. Below the panel was the main radar equipment, complete with a large scope and hand controller. A shroud was usually provided for the latter for use in daylight.

Northrop F-89D-45-NO
59th Fighter Interceptor Squadron
Goose Bay Airport, Labrador

With 682 built, the F-89D was the most numerous variant of the Scorpion. It served with Air Defense Command in the ConUS, Alaskan Air Command and Northeast Area Command, the latter having squadrons based in Canada and Greenland.

'Mighty Mouse' rockets
A total of 104 2.75-in (7-cm) FFARs (folding-fin aircraft rockets) was carried by the F-89D, and they could be launched in up to three salvoes. In one salvo all 104 could be launched in 10 pulses 50 milliseconds apart. For a two-salvo firing, the first used six pulses to fire the 62 rockets in the central honeycomb while the second employed five pulses to launch the 42 rockets in the two outer rings. On three passes, the first fired the 42 outer rockets, the second launched 32 of the central rockets and the remaining 30 were fired on the last pass. The salvoes were controlled from the cockpit, and firing could be accomplished either manually or automatically by the fire control system.

Fire control system
The heart of the F-89D was the Hughes E-6 system, which consisted of the 250-kW APG-40 radar and APA-84 rocket ballistics computer. Once a radar lock-on had been achieved, the E-6 provided steering inputs to the aircraft's F-5 or E-11 autopilot, and could automatically fire the rockets. The type of attack used was lead collision, to ensure the maximum kill probability against a bomber-sized target. A lead pursuit approach could also be used to bring the aircraft to the target's rear for identification purposes.

HVARs
Although virtually never carried, the F-89D retained the ability to carry up to 16 5-in (12.7-cm) HVARs (High-Velocity Aircraft Rockets) on underwing racks. Drop tanks could not be carried as well.

Powerplant
F-89Ds were initially powered by the Dash 33A engine, before the Dash 35 was adopted from Block 25. The Dash 41 with retractable intake screens was also fitted to some Ds, while the further improved Dash 47 was retrofitted to earlier aircraft.

Left: A view of the Hawthorne works shows F-89D Block 10s under construction, with F-89Cs in the background.

Above: A fin-top camera provides a unique vantage point for observing a 104-rocket salvo from an F-89D. Note the considerable dispersal.

also had the option of rippling the rockets, selecting two ripples (82 and 42 rockets) or three ripples (42, 32 and 30 rockets).

The nose of the F-89D was redesigned to house a Hughes E-6 fire control system with a straight tapered nosecone and a larger and flatter radome. The E-6 fire control system consisted of a Hughes APG-40 radar and an AN/APA-84 computer. The space formerly occupied by the cannon was used to carry an additional 262-US gal (992-litre) fuel tank. The F-89D could also carry extra fuel in underwing drop tanks, each containing 200 US gal (760 litres), bringing total fuel capacity to 2,834 US gal (10728 litres).

F-89Ds of the 445th FIS patrol from Wurtsmith AFB. The D model was the most widespread, serving with 12 ADC squadrons (and AAC and NEAC units) at its peak.

The first F-89D was a modified F-89B (49-2463), redesignated YF-89D. The first flight of the YF-89D took place on 23 October 1951. The first two production F-89Ds were delivered to the USAF on 30 June 1952. One hundred and twenty-five F-89Ds had been built by the time problems with the Scorpion's wings grounded the fleet. These F-89Ds remained at the factory until the wing modifications were completed.

The first F-89Ds became operational with the 18th FIS at Minneapolis/St Paul, Minnesota on 7 January 1954. Once in service, the F-89D encountered further problems, which were corrected in due course. During flights at high altitude, there were mysterious drops in engine power above 30,000 ft (9145 m). After scrupulous detective work, the drop-offs were traced to a temperature sensor element in the power control unit, and the problem was cured by shielding the unit.

In service, the F-89D's wingtip rocket tubes were often subject to corrosion which, if uncorrected, could result in an explosion in the tube during rocket firing. A new thick-walled tube corrected this problem.

Air Force squadrons flew the F-89D from 1954, among them the 18th, 61st, 64th, 318th, 337th FIS, and the 449th and 497th FIS in Alaska. From 1955, the F-89D flew with the 11th, 58th and 59th FIS in Labrdaor, and the 68th, 75th, 76th, 83rd, 321st, 432d, 437th, 445th, 460th and 465th FIS at Stateside bases. In 1956 Scorpions went to the 98th FIS, and in 1957 to the

NEAC's 61st FIS received F-89Cs at Harmon AFB, Newfoundland in 1954, but began to receive the F-89D (illustrated) the following year.

Above: The 57th FIS first received Scorpions at Presque Isle AFB, Maine, moving to Keflavik in 1954, initially with F-89Cs. D models arrived from November 1955.

Below: Far removed from the frozen north where most F-89s served, the 437th FIS flew from Oxnard AFB, California. It converted to the H model during 1956.

Maintenance work is carried out on an F-89D's rocket pod. The outer ring of tubes had metal doors, while the inner honeycomb of tubes each had protective plastic caps fitted when the rockets were in place.

29th, 54th, and 319th FIS. In 1959, the 15th and 49th FIS received F-89s.

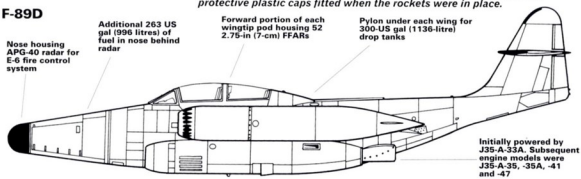
During the peak years, 30 of the 39 Scorpion-equipped squadrons were based in the northern US or in Canada. The F-89D served in ADC, Alaskan Air Command, and the Northeast Air Command until late 1958, when they began to be replaced by supersonic types such as the F-101B Voodoo and the F-102A Delta Dagger. Ex-USAF F-89Ds were then transferred to the ANG. The first ANG squadron to receive the F-89D was the 178th FIS of the North Dakota ANG, based at Fargo. The last Scorpions were finally withdrawn from active service with the USAF in 1961. The Air National Guard continued to fly Scorpions for several more years. The last Scorpion (an F-89J) left ANG service in 1969.

Three F-89Ds (52-1830, 52-1939, and 53-249) underwent modifications to their weapons system associated with the future F-89H (separate entry). One of these (52-1939) was redesignated YF-89H.

Serials: 51-400/406 (7) F-89D-1-NO, 51-407/426 (20) F-89D-5-NO, 51-427/446 (20) F-89D-10-NO, 51-11298/11317 (20) F-89D-15-NO, 51-11318/11357 (40) F-89D-20-NO, 51-11358/11407 (50) F-89D-25-NO, 51-11408/11443 (36) F-89D-30-NO, 52-1829/1868 (40) F-89D-35-NO, 52-1869/1910 (42) F-89D-40-NO, 52-1911/1961 (51) F-89D-45-NO, 52-2127/2165 (39) F-89D-45-NO, 53-2447/2461 (15) F-89D-50-NO, 53-2462/2521 (60) F-89D-55-NO, 53-2522/2581 (60) F-89D-60-NO, 53-2582/2641 (60) F-89D-65-NO, 53-2642/2686 (45) F-89D-70-NO, 54-184/260 (77) F-89D-75-NO

Total F-89Ds: 682

F-89D


Nose housing APG-40 radar for E-6 fire control system
Additional 263 US gal (996 litres) of fuel in nose behind radar
Forward portion of each wingtip pod housing 52 2.75-in (7-cm) FFARs
Pylon under each wing for 300-US gal (1136-litre) drop tanks
Initially powered by J35-A-33A. Subsequent engine models were J35-A-35, -35A, -41 and -47

F-89D test/trials

Several F-89Ds were bailed back to Northrop (reportedly using the JF-89D designation) for use as drone-launching aircraft. These carried two Radioplane drones for SAM practice. Initially the RP-70 drone was used, later upgraded to RP-76 standard. The Navy used the more powerful RP-78. The drone was redesignated AQM-38 in 1962.

This JF-89D carries a Radioplane RP-76 drone on its wing pylon. Flown by Northrop and Radioplane pilots, the F-89s launched the drones primarily to train the US Army's Nike SAM crews.

The RP-76/F-89 combination was used until 1969, its phase-out coinciding with that of the US Army's Nike missiles. Drones were also launched in support of Air Force and Navy programmes.

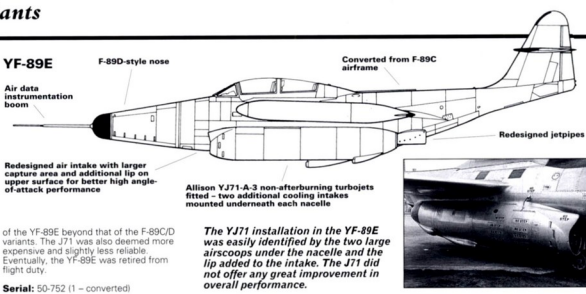
YF-89E

The YF-89E was a flying, service-test prototype for the proposed F-89E variant (below). Northrop built the YF-89E by modifying an F-89C (50-752) taken from production and fitting it with two 9,700-lb (43.14-kN) static thrust Allison YJ71-A-3 turbojets.

The YF-89E first flew on 10 June 1954 and was put through its paces for more than a year while the USAF gathered data on performance with the new engine. It was at this time that the J71 was incorporated quite successfully into the North American F-86H Sabre, giving that aircraft a substantially greater rate of climb and speed than existing models.

On the Scorpion, although the J71s provided fully 25 per cent greater thrust than operational versions and proffered greater fuel economy, the new engines did not substantially improve the performance of the YF-89E beyond that of the F-89C/D variants. The J71 was also deemed more expensive and slightly less reliable. Eventually, the YF-89E was retired from flight duty.

Serial: 50-752 (1 – converted)


YF-89E
F-89D-style nose
Converted from F-89C airframe
Air data instrumentation boom
Redesigned jetpipes
Redesigned air intake with larger capture area and additional lip on upper surface for better high angle-of-attack performance
Allison YJ71-A-3 non-afterburning turbojets fitted – two additional cooling intakes mounted underneath each nacelle

The YJ71 installation in the YF-89E was easily identified by the two large airscoops under the nacelle and the lip added to the intake. The J71 did not offer any great improvement in overall performance.

F-89E

The F-89E was a planned version of the Scorpion (to have been based on the F-89D) re-engined with a pair of 9,700-lb (43.14-kN) static thrust Allison J71 non-afterburning turbojets. The J71 engines would, it was hoped, give the Scorpion greater power and better fuel consumption, hence longer range.

After the J71-powered F-89E was abandoned, the USAF re-issued the designation F-89E to a proposed single-seat escort fighter version of the Scorpion. This latter-day F-89E was to be powered by a pair of 9,100-lb (40.48-kN) static thrust afterburning General Electric J47-GE-21 engines. The wings were enlarged and were fitted with a tapered leading and trailing edges. Armament was 108 FFARs in a pair of large pods mounted at mid-span on the wings. The main landing gear was stowed inside the pods. The nose was to be altered to carry armament; arrangements of 10 0.50-in (12.7-mm) machine-guns, six 20-mm cannons, or six MX-904 rockets were considered.

The escort fighter F-89E was projected to have a maximum speed of 688 mph (1107 km/h) and a combat radius of 1,010 miles (1625 km/h). The project did not get past the design study stage.

F-89E
Wider-span wing with thinner airfoil and tapered leading and trailing edges
APG-37 radar and six-cannon armament in nose
Single-seat cockpit
Mid-span rocket pods
General Electric J47-GE-21 engines

Also known as the Interim Escort Fighter, the F-89E was a single-seat proposal based roughly on the F-89D. The main armament would have been 108 FFARs housed in the mid-wing pods, with a variety of options for the nose, comprising 10 0.50-in (12.7-mm) machine-guns, six 20-mm cannon or six MX-904 guided missiles. The latter are depicted in this impression of the F-89E dispatching enemy fighters.

F-89F

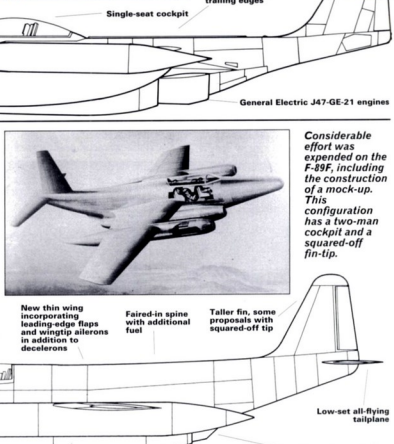
In 1950-52 Northrop and the USAF put enormous effort into the F-89F, a proposed advanced version of the F-89D. Powerplant for the F-89F was a pair of 9,100 lb (40.48-kN) static thrust General Electric J47 engines, the same engine used by the F-86F Sabre and B-47B Stratojet. Designers enlarged the F-89F wing and gave it a distinct, swept leading edge. The F-89F carried the same mid-span weapons/fuel pods as the F-89E. Designers deepened the fuselage and faired it straight back from the canopy to the vertical fin. They moved the horizontal stabilisers from the fin down to the fuselage at the base of the vertical fin.

The F-89F's primary armament was to be six Hughes Falcon air-to-air missiles, which were themselves given a 'fighter' designation of F-98, changed to GAR-1 in the new 'guided aircraft rocket' series in 1951 and, much later, to AIM-4 in the 'air intercept missile' series in 1962. The Falcon later became history's first serving air-to-air missile with another Scorpion variant (see F-89H entry).

In many respects a wholly new aircraft, the YF-89F (Model N-82) service-test ship and the operational F-89F (Model N-81) would have given the Scorpion a completely different look and would have improved speed, rate of climb, ceiling, range and overall combat effectiveness. USAF officers inspected a full-scale mock-up on 26 May 1952. But, there was trouble at the engineering table: the bigger F-89F was becoming too heavy. By August 1952, it was determined that weight growth was unacceptable. The USAF cancelled the project.

Dimensions for the F-89F were: wingspan 59 ft 4 in (18.06 m), length 59 ft 6 in (18.13 m) and height 21 ft (6.40 m). It would have been armed with 42 2.75-in FFARs housed in the front of the weapons/fuel pods. The rear portion of the pods contained 900 US gal (3410 litres) of fuel.

F-89F single-seat proposal


F-89F initially with two-seat cockpit (proposal also made for single-seater)
F-89D-style nose
New thin wing incorporating leading-edge flaps and wingtip ailerons in addition to decelerons
Faired-in spine with additional fuel
Taller fin, some proposals with squared-off tip
Low-set all-flying tailplane
Mid-span pods housing rockets, fuel and undercarriage
Allison J71-A-3 engines

Considerable effort was expended on the F-89F, including the construction of a mock-up. This configuration has a two-man cockpit and a squared-off fin-tip.

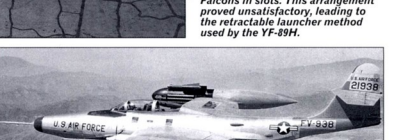
F-89G

The F-89G was a proposed advanced version of the F-89D. It was similar in many respects to the F-89F, and retained the pair of 7,200-lb (32.02-kN) static thrust Allison J35-A-35 afterburning engines used by late F-89Ds. The aircraft was to have carried the Hughes MA-1 fire control system that was being developed for the XF-106 project, and was to be armed with F-98/GAR-1 Falcon missiles. The F-89G did not progress beyond the design stage.

YF-89H

Upon the cancellation of the F-89G, the Northrop company proposed a more straightforward upgrade of the F-89D with the Hughes E-9 fire control system (a simplified version of the MA-1). The USAF agreed to the project, and three F-89Ds (52-1830, 52-1938, and 53-249) were modified to test the weapons system changes. Only one (52-1938) was redesignated YF-89H.

Illustrated here are the three F-89Ds used to validate the Hughes Falcon armament for the F-89H. Only 52-1938 (below) was officially designated YF-89H. Falcon trials had earlier been undertaken by two F-89Ds (including 51-407) with wing pods housing three XF-98/GAR-1 Falcons in slots. This arrangement proved unsatisfactory, leading to the retractable launcher method used by the YF-89H.



F-89H

The F-89H or Model N-138 (156 built) was an adaptation of the missile-armed F-89D modified to carry the Falcon air-to-air missile. It was a direct outgrowth of the abortive F-89G programme, which had been a proposal to mate the Hughes MA-1 fire-control system with the Falcon. The simplified MA-1 system, known as the E-9, was tested on three converted F-89Ds, one designated YF-89H.

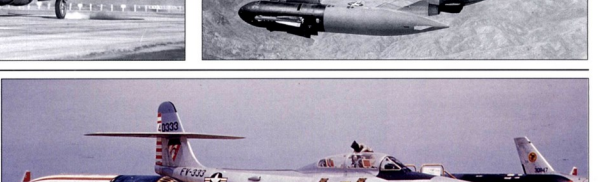
Engineers redesigned and enlarged the wingtip pods of the F-89D, with the forward third of each pod carrying six separate weapons compartments. Three of the compartments each held a single GAR-1 Falcon, and the other three each carried a pack of seven 2.75-in FFARs. The total weapons load of the F-89H was six Falcons and 42 2.75-in FFARs. The Falcons were stored inside the wingtip pods until ready for firing, when they swung out on individual launchers through a pair of fairing doors on the pods.

The Hughes GAR-1 Falcon was the first guided AAM in the world to become operational. Work on the Falcon had started in 1947. It weighed about 110 lb (50 kg) at launch, and was powered by a Thiokol solid-propellant high-impulse rocket motor. The missile was fitted with four Delta wings of extremely low aspect ratio, set at 90° to each other and each carrying a powered control surface at the rear. A 29-lb (13-kg) high-explosive warhead was carried, and the nose was fitted with a radar-homing receiver. The GAR-1 used a semi-active radar homing technique, in which the launching aircraft's radar transmitter tracked the target and the missile homed in on radar waves reflected back from the target. Maximum speed of the Falcon was about Mach 2.8, and effective range was about 4 miles (6.5 km).

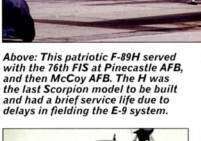
In the late 1950s, the USAF developed an IR-homing version of the Falcon. The infra-red Falcon was known as GAR-2 (later changed to AIM-4B), and it became standard practice for the Scorpion to carry three radar-homing and three IR-homing Falcons. Were the Falcons to be fired in actual combat, the plan was usually to fire one Falcon of each type at the target in order to ensure a high probability of a kill.

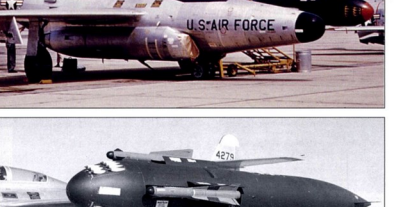
The E-9 fire control system had a 'universal computer' which enabled the crew to select the best mode of interception. The F-89H could use either a lead collision intercept mode (FFARs only) or a tail chase interception mode (Falcons and/or FFARs).

The USAF accepted the first production F-89H in September 1955. In March 1956 the first F-89Hs became operational with the 445th Fighter Interceptor Squadron at Wurtsmith AFB, Michigan, almost two years later than originally scheduled. The delays were primarily caused by problems



Above: This patriotic F-89H served with the 76th FIS at Pinecastle AFB, and then McCoy AFB. The H was the last Scorpion model to be built and had a brief service life due to delays in fielding the E-9 system.



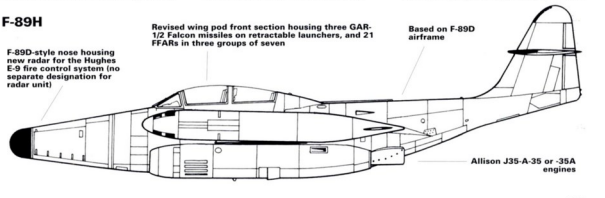


Above and left: Two views show the F-89H's wing pod loaded with GAR-1/2 Falcon missiles, while that above also has the 21 FFARs nestling in their tubes. Normally three IR-guided Falcons and three radar-homing missiles were carried, one of each being launched at a target.

which developed with both the missile launching pods and with the E-9 fire control system. As in the case of the F-89D, corrosion in the missile launching cavities could result in an explosion or misfire if left uncorrected. The E-9 fire control system had a host of minor technical problems which needed to be worked out before maximum performance could be attained from the missile armament.

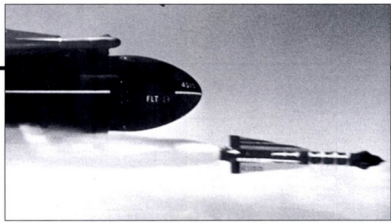
Rapid advances made in the supersonic interceptor programme, particularly with the

F-89H


Revised wing pod front section housing three GAR-1/2 Falcon missiles on retractable launchers, and 21 FFARs in three groups of seven
Based on F-89D airframe
F-89D-style nose housing new radar for the Hughes E-9 fire control system (no separate designation for radar unit)
Allison J35-A-35 or -35A engines

F-89 Scorpion Variants

After replacement by the F-102 in active-duty units, F-89Hs were assigned to the ANG from 1957. This weary-looking aircraft flew with the 103rd FIS.



An F-89H launches a Falcon test round. The GAR-1 radar-guided version was complemented by the GAR-2 with infra-red seeker.

Convair F-102A Delta Dagger, meant that the service life of the F-89H with the USAF was relatively brief. In November 1957, the first F-89H was transferred to the Air National Guard, entering service with the 123rd FIS of the Oregon ANG at Portland. F-89Hs began to equip Minnesota's 100th FIS at Minneapolis in January 1958; Montana's 186th FIS at Great Falls in April 1958; and Wisconsin's 176th FIS at Truax Field in August. By September 1959, all F-89Hs had been passed to the ANG.

Serials: 54-261/320 (60) F-89H-1-NO; 54-321/416 (96) F-89H-5-NO

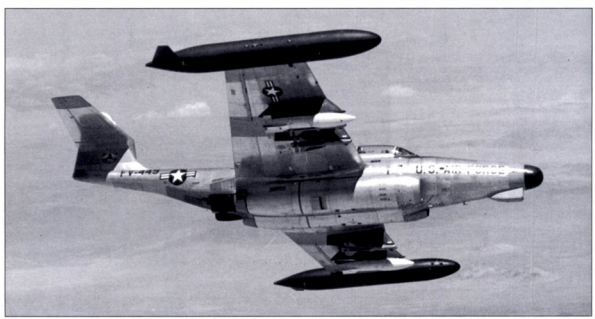
Total F-89Hs: 156

F-89J

The F-89J (Model N-160) was the F-89D modified in service to carry Douglas's MB-1 Genie nuclear-tipped air-to-air rocket. Three hundred and fifty F-89Ds were modified to F-89J standard between March 1956 and February 1958. They were taken from the D-35 through D-75 production blocks. The decision to use an atomic projectile aboard an interceptor reflected the thinking of the time: under today's rules, nuclear weapons would not be released to Air National Guard personnel.

Douglas Aircraft began developing the Genie in 1955. The National Laboratory at Los Alamos, New Mexico designed the nuclear warhead. The Genie was unguided, relying on the power of its nuclear warhead to ensure a kill. It was powered by a 36,600-lb (162.8-kN) thrust Thiokol TU-389 rocket motor. Launch weight was 822 lb (373 kg), and maximum velocity was about Mach 3.3. Flick-out fin-tips gave the Genie stability in flight and corrected for roll and gravity drop. Range of the Genie was about 6 miles (9 km). The rocket was equipped with a W25 nuclear warhead with a 1.5-kT yield. Lethal radius was estimated at 1,000 ft (305 m).

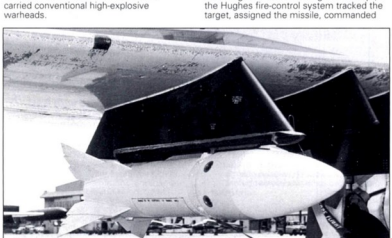
The F-89J was equipped to carry two Genies on launch rails mounted on its underwing pylons. On most F-89Js, the wingtip armament pods of the F-89D were removed and replaced by 600-US gal (2270-litre) fuel tanks, although a few F-89Js retained the standard F-89D pods. Later, the F-89J was further modified by adding two additional underwing pylons on each wing, located inboard of the Genie pylon for Falcon air-to-air missiles. The Falcons carried conventional high-explosive warheads.



The F-89J was equipped with the Hughes MG-12 fire-control system, an upgraded and more advanced version of the E-9 of the F-89D. This system made it possible for the crew to launch the Genie while in a nose-up, climbing attitude, enabling them to attack bombers flying at a much higher altitude. During an intercept, the Hughes fire-control system tracked the target, assigned the missile, commanded the pilot to arm the nuclear warhead, fired the missile, pulled the interceptor into a tight turn to escape the detonation, then triggered the nuclear warhead by remote control at the right moment.

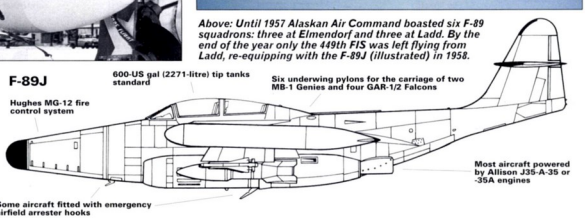
The modified F-89J became known as Weapons System 205G. Initial deliveries of the type were made during November 1956, with the 84th Fighter Interceptor Squadron at Hamilton AFB, California being the first recipient. This squadron began standing active alerts on 1 January 1957. Initially, the aircraft were armed with just one Genie rocket.

An early F-89J carries four Falcons and two Genies. The aircraft retained the ability to carry the F-89D's FFAR wingtip pods as well.



Above: Until 1957 Alaskan Air Command boasted six F-89 squadrons: three at Elmendorf and three at Ladd. By the end of the year only the 449th FIS was left flying from Ladd, re-equipping with the F-89J (illustrated) in 1958.

The Douglas MB-1 (later AIR-2) Genie nuclear rocket was developed under the codename Ding Dong. Its W-25 warhead had a yield of approximately 1.5 kT. Falcons were carried primarily to mop up any stragglers after a Genie launch, although in practice they were rarely carried and the pylons were mostly removed.


F-89J
600-US gal (2271-litre) tip tanks standard
Six underwing pylons for the carriage of two MB-1 Genies and four GAR-1/2 Falcons
Hughes MG-12 fire control system
Most aircraft powered by Allison J35-A-35 or -35A engines
Some aircraft fitted with emergency airfield arrester hooks

F-89Js went on nuclear-armed alert on 31 December 1956, and remained so until the last ANG unit stood down in 1969.

The first live firing of a nuclear-tipped Genie took place on 19 July 1957, during a series of nuclear tests known as Operation Plumb Bob. On that day, an F-89J (53-2547) fired an MB-1 over the Yucca Flats Nuclear Test Site, and the warhead was detonated at an altitude of 15,000 ft (4570 m) by a signal from the ground. This shot, named John, made the Scorpion the first interceptor in history to launch a nuclear weapon. In order to prove that the Genie could safely be used over populated areas in the US, several Air Force officers volunteered to stand on the ground directly underneath the detonation point. Following the test, these men were apparently unharmed.

The first production Genie rockets arrived in the field in May 1957. Approximately 3,150 Genies and their associated nuclear warheads were manufactured between 1956 and 1963. In 1962, the designation of the Genie was changed to AIR-2A. The F-89J, with the two nuclear Genies and the four Falcons (plus 104 FFAR rockets when carrying F-89D pods), was the most heavily-armed interceptor in the USAF inventory.

The F-89J was destined for only a brief service life, being replaced by the supersonic McDonnell F-101B Voodoo and the Convair F-106A Delta Dart from July 1959. The F-89Js were then transferred to the Air National Guard. By 1962, nine ANG squadrons were equipped with nuclear-armed F-89Js. The F-89J remained in service with the 132nd FIS of the Maine ANG and the 134th FIS of the Iowa ANG until late 1968, when they were replaced by supersonic aircraft.

Total F-89Js: 350 (converted from F-89D)

Armourers load a live MB-1 on to a 449th FIS F-89J at Ladd. This unit gave up its Scorpions in 1960.

The F-89J remained on alert with the Guard throughout the 1960s. These are the aircraft of the 116th FIS.

F-89J test/trials

In 1963, 10 F-89Js with nose radar removed and fuel tanks added were used by the US Army (with USAF pilots and markings) to test Nike missile defences in Japan. They were designated DF-89J. Another aircraft, 53-2670, was used at Edwards for high angle-of-attack trials, equipped with outsized air data booms protruding forward from both wingtip pods.

Seen at Elmendorf AFB, Alaska, during a stopover, this was one of the radarless DF-89Js flown on behalf of the US Army in Japan on drone work.

Northrop N-149 Long-Range Interceptor

The Northrop N-149, described in a company document dated 1 July 1954, would have had a Delta wing with saw-toothed leading edge, a swept empennage, and a pair of the powerful 11,350-lb (50.49-kN) thrust General Electric XJ79-GE-1 turbojet engines which were then being developed for the Convair B-58 Hustler bomber. With a cockpit configuration similar to the F-89, the N-149 was really a new aircraft. The company estimated that it could achieve a first flight in June 1957.

The N-149 would have carried GAR-1A Falcon missiles and Heavenbound rocket projectiles in retractable packages in the fuselage. It would have been 70 ft 6 in (21.49 m) long with a wing span of 51 ft 6 in (15.70 m). With its wing-mounted twin engines, drooping wings, and bicycle-style landing gear, the N-149 from the front would have closely resembled France's Sud-Est Vautour fighter-bomber.

The USAF was already far advanced in development work on the Convair F-102 when the N-149 design was proposed. Neither the N-149 nor the Heavenbound rocket was ever built.

The appearance over Britain of high-flying Junkers Ju 86s was the spur to development of a dedicated high-altitude fighter with pressurised cabin. In addition to hasty adaptations of the Spitfire and Mosquito, the Westland Welkin and Vickers Type 432 (sometimes called the 'Mayfly') were also developed. Although prototypes of both were flown, and a sizeable quantity of Welkins was built, the dedicated high-altitude fighter never saw action or service.

A late production Westland Welkin F.Mk I wheels above the clouds. Much effort was expended on the Welkin and the Vickers Type 432, but resulted in no service for either type. The most tangible benefit to the British aviation industry of the F.7/41 fighters lay in the development of pressure cabins, the Welkin being the RAF's first fighter so equipped.

An Industry of Prototypes

Welkin and Type 432

Britain's high-altitude fighter programme

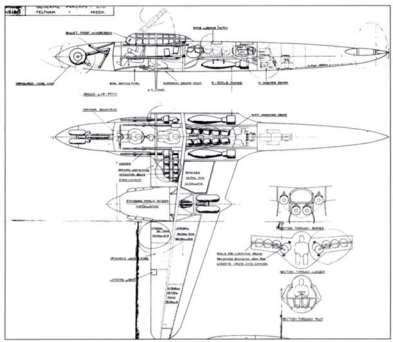
Time after time the history of military aircraft, and of weapons generally, has followed a sequence: emergence of an unexpected threat, development of a counter-weapon to meet it, disappearance of that particular threat, and immediate cancellation of the counter-weapon. This is odd, because the counter-weapon would obviously be useful in many other ways, to counter related threats which might emerge in the future.

One of these sudden unexpected threats was the appearance over southern England during the Battle of Britain in autumn 1940 of Ju 86P-1 and P-2 bomber and reconnaissance aircraft. They operated at heights up to 41,000 ft (12500 m), where they were immune to interception. Admittedly, they were unable to accomplish much. Their first few missions over England were not even detected, and it was a shock to the RAF to discover that Luftwaffe aircraft could fly higher than any British fighter – and by a huge margin.

It is an indictment of the long-established British procurement process that this should have been allowed to happen. A key to the high-flying ability of the Ju 86P was its pressurised cabin, where the atmosphere remained warm and at a comfortable pressure for human breathing. Such cabins had been known for years. The RAF had even played a central role in the development of the Bristol 138A which had set world altitude records of up to 53,937 ft (16440 m) in 1937-38, flown by Squadron Leader F. R. D. Swain and then by Flight Lieutenant M. J. Adam.

Rival to the Westland Welkin for the F.7/41 requirement was the Vickers-Armstrong 432. Its construction and wing shape showed a strong influence from the Supermarine design office.

It seems beyond belief that the Air Ministry appeared to overlook the fact that enemy air forces might develop warplanes fitted with



***Left:** This drawing shows the unsolicited General Aircraft GAL.46 Stratospheric Fighter proposal. The aircraft would have carried four 20-mm cannon (with ammunition drums in the inner wings) and four 500-lb (227-kg) bombs. The design formed the basis for GAL's submission to the F.4/40 specification which produced a prototype contract for Westland.*

***Above:** Instrumental in the development of British pressure cabins was the Vickers Wellington. Derived from the Hercules-powered Mk V, this aircraft, the Mk VI, had extended wings and a full pressure cabin, the pilot flying the aircraft from a glass dome on top of the fuselage. Equally as important were the powerplants: early versions of Rolls-Royce's two-stage Merlin 60.*

pressure cabins. This is all the more surprising when it is remembered that the same Air Ministry had, in 1936/37, been increasingly concerned about the development of ultra-high-flying airliners in the USA, such as the Lockheed XC-35 and Boeing Stratoliner. In response, it funded pressurised British airliners – the resulting Fairey and Short aircraft never flew, because of the war – as well as the General Aircraft (Monospar) GAL.41 to assist the development of pressure cabins.

The GAL.41 first flew in May 1939. At about the same time, a specification (B.23/39) was drawn up for a modified Wellington bomber with a pressure cabin resembling a steam boiler mounted above the forward fuselage, with the pilot under a frameless Perspex pimple on top. In contrast, nothing was done to develop pressurised fighters.

In the absence of official interest, General Aircraft took it upon themselves to propose a Stratospheric Fighter. The GAL.46 brochure, which arrived at the unsuspecting Air Ministry in October 1939 (a month after the start of World War II), described an aircraft powered by two Rolls-Royce Merlin engines, with a crew of two in a pressurised cabin under a long glazed canopy. Armament would have comprised four 20-mm cannon and eight 500-lb (227-kg) bombs. It was expected to reach 395 mph (634 km/h) and an altitude of 37,000 ft (11280 m).

General Aircraft was not one of the clique of firms favoured by the Air Ministry as suppliers of military aircraft. Although their brochure did spur the officials and Air Staff into thinking about pressurised fighters, General Aircraft had no chance of being asked to build one. Thus, although they submitted a tender (proposal) to the resulting F.4/40 specification, the company that was asked to build two prototypes was Westland. One reason why they were chosen is that they had available design capacity.

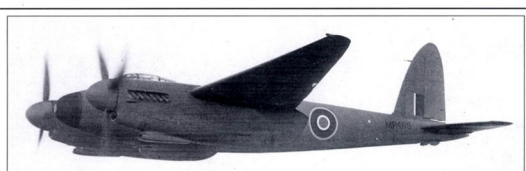
Pressurised Wellington

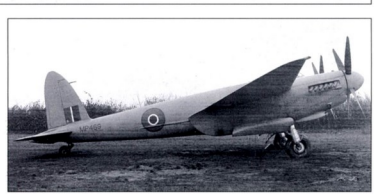
While F.4/40 was being written, Vickers-Armstrongs at Weybridge, under chief designer Rex Pierson, was forging ahead with the B.23/39 bomber, which became the Wellington Mk V. This whale-like aircraft pioneered high-altitude flying with British military aircraft. From its first flight in September 1940, it solved many serious problems in pressurisation, air conditioning, cabin sealing, and the refinement of flight-control systems, propellers, engine installations and many other items so that they would function at very low atmospheric pressures and -60°C (-76°F) temperature.

The Wellington Mk V had been designed

High-altitude Mosquito

In August 1942 de Havilland flew Mosquito MP469, a prototype for a high-altitude bomber with Merlin 61 engines and a pressurised cabin. In the face of continuing Ju 86R flights, the company was ordered on 7 September to turn it into a fighter, a feat it accomplished in seven days, fitting a four-gun fighter nose, extended wingtips and small-diameter wheels. This was later modified to NF.Mk XV standard with AI.Mk VIII radar in the nose and the armament moved to a belly tank. The performance was astounding, yet only four NF.Mk XV conversions followed, these seeing limited service with No. 85 Squadron.





These three views all show MP469 after conversion to NF.Mk XV standard, complete with AI radar in an extended nose radome and the four-gun armament moved to a belly bulge. In their brief service life in mid-1943 the Mosquitoes regularly topped 44,000 ft (13410 m). Ju 86s ended their overflights of Britain in late 1942, robbing the Mk XV of its original task, yet development of the Welkin and Type 432 continued.

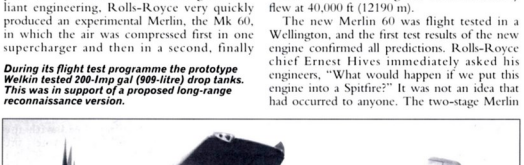
Above: Seen in October 1942, shortly before its first flight, the Welkin prototype displays the rounded fin which was fitted for the first two months of flight test. These showed up numerous problems, including over-heaviness of all controls and some stability problems.

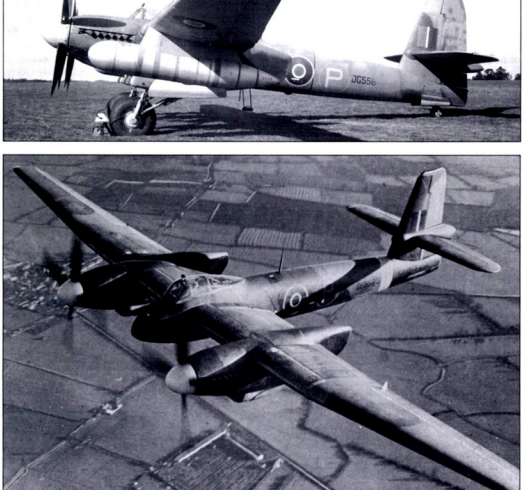
around turbo-supercharged Bristol Hercules engines, but Rolls-Royce was invited to compete. With a combination of cunning and brilliant engineering, Rolls-Royce very quickly produced an experimental Merlin, the Mk 60, in which the air was compressed first in one supercharger and then in a second, finally passing to the engine through an intercooler to increase its density. At a stroke, this 'two-stage' supercharging raised the full-throttle height of the Merlin from around 20,000 ft (6096 m) to 30,000 ft (9145 m). The maximum power at the latter height was approximately doubled. This new Merlin was to provide the key to the improved long-span Wellington Mk VI, for which it had been designed, which eventually flew at 40,000 ft (12190 m).

The new Merlin 60 was flight tested in a Wellington, and the first test results of the new engine confirmed all predictions. Rolls-Royce chief Ernest Hives immediately asked his engineers, "What would happen if we put this engine into a Spitfire?" It was not an idea that had occurred to anyone. The two-stage Merlin not only utterly transformed the Spitfire, but it also made possible the high-altitude fighters described in this article.

At Weybridge, Rex Pierson already had a team working on a twin-engined fighter, the Vickers-Armstrongs Type 414, which in 1940 was refined into the Type 420 with special high-altitude features. This again remained on paper, being further developed as the Type 432 to meet the revised F.7/41 specification. Because of the Ju 86P overflights, two Type 432 prototypes were quickly ordered to be built. There were two more possible high-altitude fighters. By far the most exciting was the Gloster G.41, first named Thunderbolt and then Meteor. To be powered by two of Frank Whittle's Power Jets units, this was very much an unknown quantity but was expected to have outstanding performance at high altitudes. Sadly, poor management of the vital engines added at least one year to the programme, so none of the prototypes flew until 5 March 1943 (with Halford's de Havilland engines). It was only when Rover was replaced by Rolls-Royce that the British jet programme at last had proper effort put into it, so that in July 1944 the Meteor became the first jet in squadron service in the world. By that time, the high-altitude threat was considered to have disappeared.

During its flight test programme the prototype Welkin tested 200-Imp gal (909-litre) drop tanks. This was in support of a proposed long-range reconnaissance version.





High-altitude Mosquito

At Hatfield, de Havilland Aircraft had in August 1942 completed MP469, the prototype of a high-altitude Mosquito bomber with a pressure cabin and two of the first Merlin 61 engines, driving four-bladed propellers. As a result of the Ju 86P overflights, in seven days de Havilland converted this aircraft into a high-altitude fighter.

The resulting Mosquito XV had a span extended to 59 ft (18 m), four machine-guns in the nose and a stick-type control column. Weight was saved by removing outer-wing tanks, some armour and other gear, and fitting smaller wheels with smooth tyres. On 14 September 1942 this aircraft was taken by John de Havilland to 43,500 ft (13260 m). It seems indisputable that no other contemporary fighter in the world could have reached this altitude.

Later, four production Mk XV fighters were delivered (DZ366, 385, 409 and 417), with the machine-guns in a belly pack to enable Mk VIII airborne interception radar to be fitted in the nose. No more Mosquito Mk XV fighters were built simply because there seemed to be no requirement. And yet, these aircraft were so much better than the troublesome Vickers and Westland aircraft that followed that it is difficult to see why the latter were continued.

Even at the height of a world war, with the outcome very uncertain, weapon projects acquire a kind of momentum of their own. In 1940 Lord Beaverbrook, the 'czar' of aircraft production, would never have permitted the Vickers and Westland high-altitude fighters to continue, but by 1942 things had eased. Perhaps the only possible justification for their existence was that they were armed with cannon, while

Initial handling problems with the prototype resulted in considerable redesign, including a larger squared-off fin with rod and mass balancing, and a considerable lengthening of the engine nacelles. The Welkin never approached the Mosquito's superb handling or performance.

A production order for 100 Welkin F.Mk Is had been placed long before the prototype flew, with a follow-on batch for 200. The Westland works at Yeovil eventually built two prototypes, 75 Mk Is, and 26 Mk Is delivered without engines.

the Mosquito Mk XV carried only 0.303-in (7.7-mm) machine-guns, but it would have been the simplest thing in the world to base the Mk XV on other Mosquito fighters, which all had four cannon.

In the event, the Westland aircraft made its maiden flight on 1 November 1942, seven weeks before the Vickers. Whereas the Vickers fighter was aerodynamically an ordinary fighter which happened to have a pressurised cockpit, the Westland was obviously designed specifically for reaching the greatest altitude possible. The wing had an aspect ratio of 10.65, the span being 70 ft (21.34 m). Apart from the Curtiss XP-71 (82 ft 3 in/25.07 m), which was never completed, the only interceptor to surpass this was the Ju 388J, at 72 ft 2 in (21.9 m). The 70-ft span was equalled by the Lockheed XP-58. Where the British aircraft differed was that, while the Ju 388J and XP-58 were just large multi-seat aircraft, the Westland was an ordinary-size single-seater with a huge span.

Specification F.4/40 made many specific demands, including a target speed of 450 mph (724 km/h), a cabin altitude of 10,000 ft (3050 m) at an actual target ceiling height of 45,000 ft (13720 m), and an armament of six 20-mm cannon. Under technical director W. E. W. 'Teddy' Petter, chief designer Arthur Davenport based the F.4/40 interceptor on the existing Whirlwind. Apart from the greater size, and the pressurised cockpit, the only obvious difference from the earlier fighter was that, instead of projecting ahead of the nose, the guns were placed in a row across the bottom of the fuselage.

This enabled the nose to be kept very short, giving the pilot a good view ahead. Later, the guns were reduced in number to four, and instead of being mounted near the top of the fin the tailplane was fixed about one-third of the way up. This was considered the best compromise to prevent disturbed wakes behind the extended flaps and to ensure good spin recovery at high altitudes. In 1941 the aircraft was slightly amended to meet the same F.7/41 specification as the rival Vickers aircraft.

Welkin anatomy

The new design was called the P.14, and in 1942 it was named Welkin, an ancient name for the sky. Like the Whirlwind, it was a straightforward stressed-skin aircraft made of aluminium alloys, except for the rear fuselage which was Elektron (magnesium alloy). The single-spar wing consisted of a horizontal centre-section with slight taper, and outer panels with increased taper and dihedral. The centre-section had split flaps with a landing setting of 42°, and the outer panels had long one-piece ailerons with electrically driven trim tabs. Like the left/right elevators and upper and small lower rudder, the ailerons were driven by rods and pivoted levers.

The prototype P.14 was initially powered by two Merlin 61 engines, but later the standard engines comprised one Merlin 72 or 76 (port) and one Merlin 73 or 77 (starboard); the latter was fitted with a Roots-type positive-displacement blower to supercharge the cockpit. There is no doubt about this, and chief test pilot Harald Penrose clearly remembered occasions when failure of the starboard engine caused loss of cabin pressure. In contrast, several contemporary accounts, including the 1945-46 Jane's, state that the odd-numbered engine was on the port side.

For the first flight, the propellers were de Havilland four-bladed 4/4000 series of 13-ft (3.96-m) diameter, with constant-speed control over the flight range but unable to be feathered. This decision led to some dangerous problems.

Westland Welkin Cockpit

1 Three-way cock (fuselage tank)
2 Flaps lowering lever
3 Undercarriage emergency lowering lever
4 Undercarriage operating lever
5 Beam approach and landing lamp switches
6 Supercharger control switch
7 Positive coarse pitch stops
8 Friction adjusters
9 Propeller control levers
10 Slow-running cut-out control (port)
11 Junction boxes
12 Peg for harness leg-strap
13 Fuel tank instruction plate
14 Trim-tab motor switchbox
15 Throttle levers
16 Map case
17 Fuel cock switches
18 Booster push-buttons
19 Oil dilution push-buttons
20 Engine starting push-buttons
21 Compass card holder
22 Radio controller
23 Supercharger warning lamp
24 Magneto switches
25 Aileron and rudder tab position indicators
26 Elevator tab and flaps position indicators
27 Clock
28 Undercarriage position indicator
29 Engine speeed-limitations plate
30 Undercarriage warning lamp (with test switch immediately above)
31 Lamp
32 Remote contactor
33 Gunsight switch
34 Gunsight socket
35 Cockpit lamp switch
36 Gunsight master switch
37 Gunsight mounting
38 Lamp
39 Oxygen regulator gauges
40 Compass lamp switch
41 Cockpit lamp switch
42 Compass lamp
43 Airspeed indicator (ASI)
44 Artificial horizon (partially obscured by grip)
45 Rate of climb/descent indicator
46 Altimeter
47 Direction indicator (partially obscured by grip)
48 Turning indicator
49 Gun and camera firing switches (on grip)
50 Brake lever
51 Rudder bar adjuster
52 Compass (partiallly obscured by column)
53 General data card plates (on glove box cover)
54 Rudder pedals
55 Control column
56 Pilot's seat
57 Engine fire-extinguisher push-button
58 Boost gauges
59 Engine speed indicators
60 Oil inlet temperature gauges
61 Oil pressure gauges
62 Fuselage fuel-tank pump warning lamp
63 Radiator temperature gauges
64 Canopy sliding hood operating handle
65 Generator warning lamp
66 Identification lamp switchbox
67 Remote contactor plug and socket
68 Lamp
69 Identification lamp selector switch
70 Wedge plate for camera indicator
71 Pneumatic high-pressure gauge
72 Brake triple-pressure gauge
73 Footage indicator plug stowage
74 Peg for harness leg-strap
75 Slow-running cut-out control (starboard)
76 Air temperature gauge
77 Voltmeter
78 Cabin pressure warning lamp
79 Suction pump gauge
80 Recognition lamps switch
81 Demolition push-buttons
82 Fuel contents gauges
83 Map case
84 ARI 525 switches
85 Pressure head, R/T supply, R/T contactor switches
86 Navigation lamps switch
87 Camera switch
88 Suction pump change-over cock
89 Junction boxes
90 Rounds counter
91 Cabin altimeter
92 Cabin pressure and ventilation control
93 Recognition signal firing lever and discharge damper
94 Crowbar stowage
95 Seat actuating lever
96 Harness release lever

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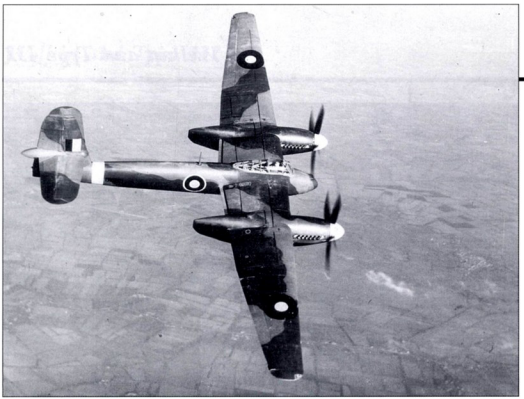


The wide-span wing of the Welkin, so necessary for high-altitude flight, seriously impaired its manoeuvrability at lower altitudes.

This is the fourth production Welkin, seen outside the Yeovil works, wearing standard camouflage as applied to the first batch. The first example flew in August 1943, assigned to A&AEE Boscombe Down for service trials. Several of the production machines were used by the A&AEE, while others flew on trials work at Farnborough and with propeller manufacturers Rotol.

Whereas the prototypes had Merlin 61s, the production F.Mk Is had Merlin 70-series engines. The first aircraft were intended to have three-bladed fully-feathering de Havilland propellers as used by the Mosquito, but these showed considerable vibration, and the early Welkins retained the non-feathering constant-speed four-bladed propellers of the prototypes.

A total of 400 Imp gal (1820 litres) of fuel could be carried in four tanks in the wing centre-section outboard of the engines, those ahead of the spar being of 60-Imp gal (273-litre) capacity and those behind being 140-Imp gal (635-litre). For extra range, 70 Imp gal (320 litres) could be loaded into a vertical drum tank in the fuselage and a 200-Imp gal (910-litre) drop tank could be hung under each wing.

Carburettor air was rammed in an inlet under each engine. The main engine glycol radiator, intercooler and oil radiators were all inside the wing inboard of the nacelles, behind the spar. Cooling air was supplied through long 'letter box' inlets in the leading edge, and escaped between the inboard flap and the wing, the flap setting being thermostatically adjusted to control coolant temperature.

Seen from the front, the considerable thickness of the Welkin's wing is apparent. The compressibility effects of the thick wing severely limited the aircraft's diving speed.

All three units of the landing gear retracted fully into bays with twin doors. Actuation was by a 3,000 lb/sq in (211 kg/cm^2) Dowty 'Liveline' hydraulic system, which also drove the flaps. Each main unit had two Lockheed oleo shock absorbers and wheels with Dunlop tyres and drum brakes. Armament comprised four British Hispano Mk II 20-mm guns in the bottom of the fuselage under the pressure cabin. By 1941 it had been discovered (rather, rediscovered) how to feed this gun with a belt, rather than a 60-round drum. Immediately behind the cabin were the four upright box magazines, housing 138 rounds for each of the inner guns and 145 for the outers.

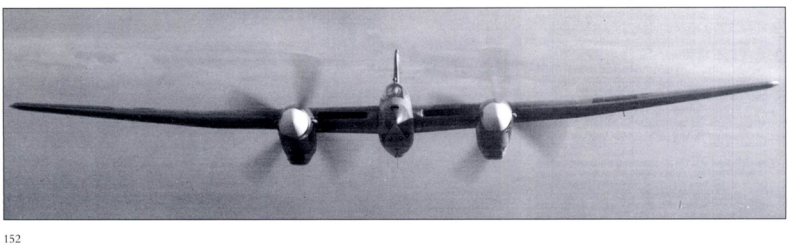
By far the biggest development task was the pressure cabin. Even with the experience of the Monospar GAL.41, which was primitive in the extreme, Britain had virtually no background of technology to support the necessary sealing, pressurisation, filtration, humidification, temperature control and, above all, discharge valves to enable a satisfactory system to be designed. The breakthrough at Yeovil was that, in 1939, Bill Widgery, senior Westland aerodynamicist, had read in *Aviation Week* a full description of the system used in the Boeing Stratoliner.

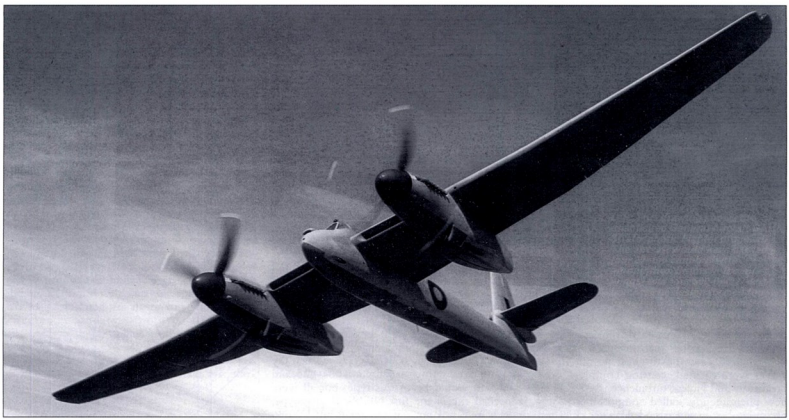
He took an ordinary altimeter and reconnected the aneroid stack output to control a spring-loaded valve governing the escape of air from the cabin. After bench tests this device was fitted into a Spitfire, whose engine drove a Roots compressor. The cockpit was sealed with Bostik, and a modified two-layer hood was fitted with a peripheral seal inflated by a pipe from the compressor. This aircraft, tested in 1939, preceded the development of the pressurised Spitfire Mks VI and VII. It was crucial in enabling Westland to design the Welkin.

Pressurised cabin

By late 1942 pressurised cockpits and cabins were being tested in almost every combatant country. The big Westland fighter had one of the neatest installations, with minimal frames to obstruct what was by any standard an outstanding all-round view for the pilot. In front was the usual fixed windscreen, with an optically flat, bullet-proof, central panel. Next came the main canopy or hood, which opened by sliding to the rear on rails. This was faired in by a fixed transparent rear section.

The windscreen front panels and main hood were both two-layer sandwiches of special Perspex and, upon sealing and turning on cockpit pressure, hot air was rammed in at an inlet above the nose, passed through a glycol heater (in effect part of the engine radiator circuit) and then circulated through the windscreen and hood. The fixed rear part of the canopy was outside the pressure cabin, which was sealed at the rear by a bullet-proof Perspex multi-ply slab immediately behind the pilot's





Later production Welkins were painted in a cerulean blue scheme as befitted their intended high-altitude role. By the end of 1943 the Welkin was effectively dead in the water, although two were briefly assigned to the Fighter Interception Unit at Wittering, the nearest the aircraft got to entering service.

head. As already noted, all joints were sealed by pneumatic rubber gaskets.

The first of the two Welkin prototypes, DG558/G (suffix G signified a secret aircraft, always to have an armed guard when parked), still commonly referred to at Yeovil as the F.4/40, was finished in standard day-fighter green/grey camouflage, with a duck-egg band round the rear fuselage and spinners painted the same colour. Chief test pilot Harald Penrose made the first test flight on 1 November 1942. All went well, apart from the fact that when the pressurisation was working the pilot roasted, rapidly becoming soaked in perspiration. Nothing was done about this until, many flights later, Penrose went down with pneumonia after climbing out into sub-zero January temperature. The first dozen or so test flights revealed little more than the usual imperfections in handling. With such a great wing span, the aircraft's rate of roll could never approach that of smaller fighters, and prolonged efforts were needed to improve all three axes. The ailerons, overbalanced at low speeds and too heavy at high speeds, were eventually made as good as could be expected. The rudder was increased in area, and the big horn balance was replaced by a rod with a mass balance at the new squared-off top. The elevators, and to some degree the tailplane, were largely redesigned, but it was not until the engine nacelles were greatly lengthened and reshaped that handling became acceptable.

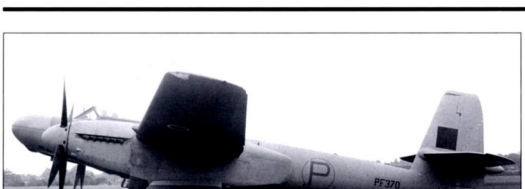
Discovering compressibility effects

In any case, by far the biggest problem was frequent failures of the engines and, especially, the propellers. The first prototype alone suffered five such emergencies in its first 10 months. Moreover, Penrose and other Westland pilots soon began to experience a previously unknown phenomenon: at high altitudes any attempt carry out a maximum-speed test caused buffeting likened to running over cobblestones.

It was just beginning to be appreciated that, at altitudes around 33,000 ft (10000 m), there is such a thing as CAT (clear air turbulence). At first the cobblestone effect was put down to this natural phenomenon, and regarded merely as a nuisance which could make gun-aiming difficult. However, as soon as Welkin diving trials began, the 'cobblestones' suddenly became violent and dangerous. As Penrose gathered speed in his first high-altitude dive, without warning, all hell was let loose. The vertical oscillation was terrifying, the outer wings appearing to flap up and down over an amplitude of several feet. Penrose did not know if he could ease out of the dive without the wings coming off, but, as the speed fell, the vibration suddenly stopped.

The vibration was unfailingly encountered as soon as indicated airspeed reached 270 mph (435 km/h), or about 500 mph (800 km/h) true. Later, Penrose said that in its milder forms the experience was "like tobogganing down a flight of stairs on a tea tray." Chief designer Petter was intrigued, and kept asking for dives to be repeated. In fact, they were lucky not to have had an inflight structural failure, because in

Welkins were used for a few engine tests, including this Merlin RM16SM installation with beard-type radiators flown in June 1945. This provided a small increase in speed, and would have been employed if redundant Mk I fighters had been modified for photo-reconnaissance.



The sole Welkin NF.Mk II was produced by conversion of a Mk I, although it first flew with a newly-assigned serial. It was proposed to complete the last 60 aircraft to the two-seat night-fighter standard.

reality the air was being so sharply accelerated across the thick wings that the speed of sound was reached near the thickest point. Shock waves were formed, causing complete flow breakaway and violent turbulence. By 1943 this new phenomenon, called compressibility, was becoming better understood. Hawker chief test pilot George Bulman studied it in the USA and wrote a booklet issued to all British test pilots.

The vital factor determining the onset of compressibility is thickness/chord ratio. It so happened that, of all wartime aircraft, the best thickness/chord ratio was found on the Spitfire, which in 1944 was dived to a true Mach number of 0.92. With the Welkin the limit was more like 0.76. There was no way Westland could either increase the chord – although they tried – or reduce the thickness. In practice, this meant that if a target aircraft dived away, the Welkin was unable to follow. This was an undoubted handicap for an interceptor.

Welkin production

Even without this crippling shortcoming, the apparent absence of high-altitude targets resulted in the Ministry of Aircraft Production losing interest in the Welkin. In 1941 an order had been placed for 100, quickly followed by a second order for 200. The first production aircraft, DX278, flew in August 1943. Subsequently, all 100 were delivered, as DX278-295, 308-349, 364-389 and 407-420. At the end of the first batch the day fighter camouflage was replaced by the overall cerulean blue previously used only by the Photographic Reconnaissance Unit, with B-Type red/blue insignia. The aircraft suffered various accidents, some of the more serious still being due to the propellers, but the problems were solved by simply parking the brand-new aircraft at the Maintenance Units at Kemble or Tinwald Downs (Dumfries).

Two saw brief service at the Fighter Interception Unit at Wittering in May-June 1944, and others were briefly flown at Boscombe Down, Farnborough and by Rotol Ltd on propeller development from Staverton. The second batch, to have carried serials from NT623 to 872, was cancelled, though not in time to prevent NT623 from being completed.

Only one of the many proposed modified versions was actually continued. Two prototypes were ordered of the Welkin NF.Mk II night fighter; this type featured a greatly enlarged nose housing AI.VIII radar managed by an operator facing aft in an added rear cockpit. Among other minor changes, the rudder was increased in height. It was planned that the final 60 production aircraft (NT801-823 and 836-872) would be of this type, but all were cancelled except the first NF.Mk II prototype, which itself was not a new aircraft but DX386 renumbered as PF370. It first flew on 23 October 1944, and was the only Welkin to appear in public, at the 1946 SBAC display at Farnborough. It had quite a long life, ending with the third serial of WE997. In 1944 the second prototype, DG562, was used for experiments in which power at high altitude was considerably boosted by injecting additional oxygen from a tank of liquid oxygen. The British aircraft industry had no experience of handling this liquid, which has a temperature of -183°C (-298°F), and it is remarkable that no disaster occurred. Penrose believed he exceeded 400 mph (644 km/h) and climbed above 50,000 ft (15240 m) using liquid-oxygen injection. The only other significant modification was applied to the same aircraft. In early 1945 it was fitted with experimental RM16SM Merlin engines, giving increased power at over 25,000 ft (7620 m). For no obvious reason, the cooling system was completely redesigned, the radiators being located directly under the engines and the inboard leading edge being skinned over. Top speed was increased to 398 mph (640 km/h) at just over 30,000 ft (9145 m). The objective had been to turn the Welkin into a photo-reconnaissance aircraft, but, since it was considerably inferior to the existing Mosquitoes in speed and range, the idea was dropped.

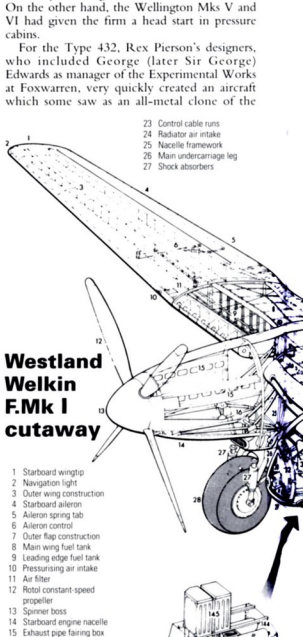
The one lasting contribution made by the Welkin programme was that Bill Widgery stayed in the pressurisation business and started a totally new product line for Westland, beginning with the automatic cabin air discharge valve. In 1947 this led to the formation of a wholly owned subsidiary, Normalair Ltd, which has continued to this day.

Vickers-Armstrong fighter

The second high-altitude fighter, the Vickers 432, was designed to meet Specification F.7/41 from the outset. As already noted, Vickers-Armstrongs (Aircraft) had previously worked on the Types 414 and 420, and the 420 needed only minor changes to meet the 1941 requirement. Engines remained two Merlin 61s, driving four-bladed Rotol propellers which, unlike those of the first Welkins, were designed to feather. Two prototypes were ordered in late 1941, with serials DZ217 and 223.

The associated company Supermarine Aviation was experienced in all-metal stressed-skin structures, but the parent firm at Weybridge had made no comparable aircraft; its nearest example was the more primitive Type 279 Venom. This was a result of concentration on fabric-covered geodetic airframes for the Wellesley, Wellington, Warwick and Windsor. On the other hand, the Wellington Mks V and VI had given the firm a head start in pressure cabins.

For the Type 432, Rex Pierson's designers, who included George (later Sir George) Edwards as manager of the Experimental Works at Foxwarren, very quickly created an aircraft which some saw as an all-metal clone of the



1 Starboard wingtip
2 Navigation light
3 Outer wing construction
4 Starboard aileron
5 Aileron spring tab
6 Aileron control
7 Outer flap construction
8 Main wing fuel tank
9 Leading edge fuel tank
10 Pressurising air intake
11 Air filter
12 Rotol constant-speed propeller
13 Spinner boss
14 Starboard engine nacelle
15 Exhaust pipe fairing box
16 Engine mounting framework
17 Main undercarriage well
18 Undercarriage position indicator
19 Flap controls
20 Fire extinguisher
21 Nacelle tail fairing
22 Inboard flap section
23 Control cable runs
24 Radiator air intake
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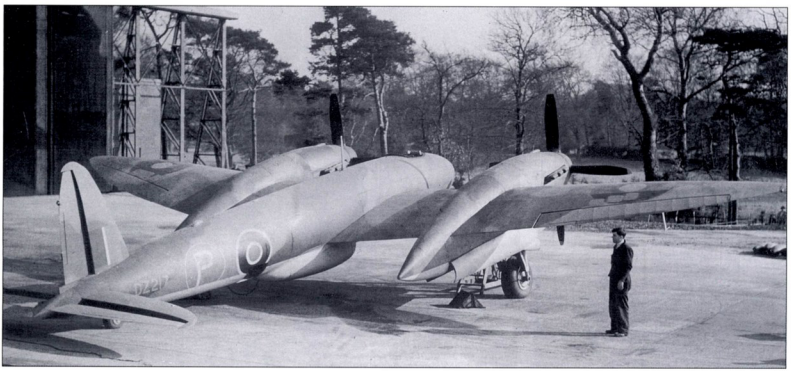
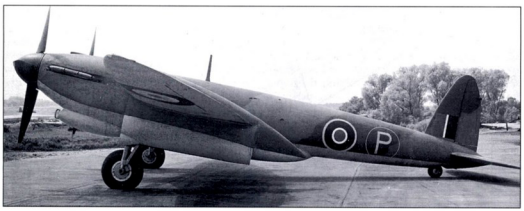
32 Front bulkhead
33 Cabin heater
34 Compass





The Spitfire-like elliptical wing of the Type 432 is clearly apparent here. Despite having a much shorter wing span than the Welkin, performances of the prototypes were comparable. The only completed prototype flew sporadically until the end of 1944.

Above: The Type 432 stands outside the Foxwarren works. Its uncanny resemblance to the well-known de Havilland twin-engined fighter led to it being called the 'Tin Mossie'.

section semi-monocoque fuselage had a forward portion comprising a tapered pressure cabin. The pilot, the sole occupant, sat under a Perspex dome of sandwich construction. This was hinged on the right, but in flight it was sealed by inflated tubes and demisted by hot air pumped round between the inner and outer layers, as in the pressurised Wellingtons. In emergency the dome could be jettisoned. The engines were mounted on welded steel-tube cradles, and like the Wellington Mk VI had the exhaust pipes from adjacent pairs of cylinders joined, as in the earlier single-stage Merlin engines (all other two-stage installations had individual stubs, six on each side). About 410 Imp gal (1864 litres) of fuel were housed in protected tanks in the wings. In the centre fuselage were the large 120-round box magazines for the six Mk II Hispano cannon, which were arranged side by side in a large demountable box under the belly. The single Type 432 prototype, DZ217, did not have the armament fitted, nor the gyro-type gunsight, and its pressurisation system was never connected.

Tunnel testing at both Weybridge and at the National Physical Laboratory revealed that at high angles of attack the airflow over the inner wings broke down completely, especially inboard of the engines, well before a normal stall might have been expected. There was no time for any major redesign, and all that could be done was to add a false leading edge, increasing chord at the root and giving leading-edge taper inboard of the engines. This automatically improved the aerodynamics of the radiator inlets. It was also apparent that directional stability would be marginal, as anyone might have guessed by looking at the relatively tiny vertical tail.

Handling idiosyncracies

Company test pilot D. W. 'Tommy' Lucke was delighted to be assigned to this interesting fighter, which promised to combine outstanding high-altitude performance with devastating firepower. It was completed at Foxwarren in December 1942 and was painted in regular day fighter camouflage, but with underwing roundels of traditional A-type. It could have been flown from either Weybridge or Wisley, but instead was dismantled and taken by road to Farnborough. Here it proved to have unacceptable taxiing characteristics, but after the angle of the paired main legs had been altered to move

DZ217, the prototype Type 432, is seen under final assembly. It first flew two months after the Welkin, but was officially cancelled at the end of 1943. At the time production of the Welkin was too far advanced to warrant its cancellation.

Above: The Type 432 looked purposeful enough, but its performance was not astounding. Great attention was paid to detail streamlining, with flush-rivetting and polishing used to smooth out the skin as much as possible.

Left: The Type 432 'Mayfly' used the same inboard leading-edge air intake arrangement as the Welkin. The wing was constructed partly conventionally and partly using the 'lobster claw' torsion box technique.

	Welkin I	Vickers 432
Engines	two Merlin 176/77	two Merlin 61
Take-off power (each)	1,650 hp (1230 kW)	1,565 hp (1167 kW)
Dimensions		
Span	70 ft 0 in (21.34 m)	56 ft 10½ in (17.34 m)
Length	41 ft 6 in (12.65 m)	39 ft 3 in (11.96 m)
Wing area	460 sq ft (42.73 m²)	450 sq ft (41.80 m²)
Weights (with fixed equipment)		
Empty	64,420 lb (6541 kg)	16,373 lb (7427 kg)
Loaded	19,840 lb (8999 kg)	20,168 lb (9148 kg)
Performance		
Maximum speed at height	387 mph (623 km/ h) 26,000 ft (8530 m)	est 435 mph (700 km/h) 28,000 ft (8534 m)
Service ceiling	44,000 ft (13411 m)	43,500 ft (13259 m)
Climb to 15,000 ft (4570 m)	5.5 min	5 min
Range	1,500 miles (2415 km)	1,500 miles (2415 km)
Armament	four 20-mm	six 20-mm

the wheels 3 in (76 mm) further back, there was no problem. Lucke made the first flight on 24 December 1942. He had intended to make a fast taxi test, but before he expected it the aircraft became airborne, so he climbed away.

Handling was initially good, but at 240 mph (386 km/h) the stick slammed hard over to one side. It needed all Lucke's strength to centralise it, and it was clear that the ailerons were dangerously overbalanced. The first flight was otherwise satisfactory, and the landing no problem, although it proved impossible to avoid doing a 'wheeler', touching on the main wheels first. In all the subsequent testing nobody ever succeeded in making a three-point landing, one reason thought to be the strong ground effect of the low horizontal tail. Further testing gradually solved the aileron problem, the original Irving ailerons being replaced by Westland type with the leading edge joined by flexible strips to the rear spar. However, it appears that lateral control was never made wholly acceptable. On one occasion slight negative *g* caused the left engine to cut dead at 2,500 ft (760 m). The aircraft went into a rapid left-hand spin, from which it was reluctant to come out. Lucke eventually restored full power on both engines and regained control "as the roof slates of the Queen's Hotel [Farnborough] began to assume abnormally large proportions." There is no record of deliberate spinning trials, and none of the three suggested larger vertical tails was ever fitted. The only visible modifications were the new inboard leading edge and an additional extension along the same line outboard of the engines to cure a tendency to stall at that point. This gave a distinctive kinked wing shape.

Programme cancellation

In May 1943 the second prototype, which would have incorporated minor modifications including a larger fin, was cancelled. At the end of that year the entire programme was cancelled. DZ217 had flown 28 times, three of the tests being by chief test pilot 'Mutt' Summers. It had proved to be generally a very fast and impressive aircraft. Compared with the Welkin, despite its much shorter wing span and much higher wing loading (because it was heavier), it could climb at a similar rate to a similar height, and it did not suffer from a shock-stall problem in dives. The only unresolved problem was a tendency for the engines to cut at about 24,500 ft (7470 m), which drastically curtailed high-altitude flying. In flight, DZ217 looked and sounded to ground observers uncannily like a Mosquito, except for the pointed elliptical wings. It continued briefly as a research aircraft, engaged in aileron development for the big Windsor heavy bomber. This work was completed by the end of 1944, and in spring 1945 this unique aircraft was scrapped. **Bill Gunston**

Specification F.7/41 resulted in 104 complete aircraft (103 of them Welkins), not one of which entered service. Most of the later Welkins, like this aircraft, were sent straight from the works for storage and subsequent scrapping.

INDEX

Page numbers in **bold** refer to an illustration

2-PA (see Republic)
138A (see Bristol)
146 (see Martin)
299AB Executive (see Boeing)

A

A-1 (AD) Skyraider (see Douglas)
A-4 (AAD) Skyhawk (see Douglas)
A4D-1 *et seq* (see Douglas)
A6M Zero-Sen ('Zeke') (see Mitsubishi)
A 21 (see Saab)
A 21A *et seq* (see Saab)
A 29B (see Saab)
A 32A Lansen (see Saab)
AC-47 (see Douglas)
AD (see Douglas A-1 Skyraider)
Admiral Scheer: 52
Aichi D3A 'Val': 51
Airacobra, P-39 (see Bell)
Air Commandos
1961-1966: the early years: 104-117, **104-117**
Alacrity, HMS: 10, 11
Antrim, HMS: **13**, 14, 18, 25
Ardent, HMS: 15, 18, 25
Argentina
Air Force (Fuerza Aérea Argentina): 4-27
Commands
Air Defence Command (Comando Aérea de Defensa): 6, 7
Southern Air Command (Fuerza Aérea del Sur): 6, 8-11, 13, 19-22
Military Air School (Escuela de Aviación Militar): 7
Army: 9, 17, 22, 26
Coast Guard: 26
Navy (Comando Aviación Naval Argentina): 4, 12, 17, 25, 26
Argonaut, HMS: 14
Arrow, HMS: 10, 11, **11**
AT-28 (see North American)
Avenger, HMS: **22**
Avro
Lancaster: 118-124, **118-120**
Lancaster B.Mk I (Special): **122**, 123, **123**
Lancaster B.Mk III: 123, 125, **125**
Lancaster Mk VII: 124, 125
Lincoln: 124, 125, **125**
Manchester: 118
Vulcan: 6, 7, 12, **12**, **119**, 125, 125, **125-127**

B

B-9 (see Boeing)
B-10 (see Martin)
B 17 (see Saab)
B-17 Flying Fortress (see Boeing)
B-17B *et seq* (see Boeing)
B-18 (see Douglas)
B 18 (see Saab)
B-24 Liberator (see Consolidated)
B-25 Mitchell (see North American)
B-26 Invader (see Douglas)
B-26 Marauder (see Martin)
B-26B *et seq* (see Martin)
B-29 Superfortress (see Boeing)
B-34/PV-1 Ventura (see Lockheed Martin)
B-36 (see Convair)
B-47 Stratojet (see Boeing)
B-52 Stratofortress (see Boeing)
B-57 Canberra (see Martin)
B-58 Hustler (see Convair)
B-299 (see Boeing)
BAe Sea Harrier: 4-11, 13-18, 20-25, **20**, 27
Bearcat, F8F (see Grumman)
Beaufighter (see Bristol)
Bell
Model 212: 14
P-39 Airacobra: **55**
UH-1A: 110
UH-1D: 115
Bf 109 (see Messerschmitt)
Bf 109A *et seq* (see Messerschmitt)
Blackburn/Hawker Siddeley Buccaneer: 127
Black Widow, P-61 (F-61) (see Northrop)
Boeing
299AB Executive: 69
B-9: 40
B-17 Flying Fortress: 38-103, **38-103**
B-17B: **43-46**, 48-50, 92
B-17C: 45, 46, **46**, **47**, 48-51, **51**, 53-56, 60, **68**, 76, 93, 96
B-17D: 45, 46, **46**, 48-51, **48**, **49**, **51**, 53, 54, 56, 70, **88**, 93, 96
B-17E: 46-51, **50-55**, 56-62, **56**, **62**, 64, 66, 67, 70, 75, 76, **79**, **82**, **84**, 86-89, **89**, 96, **96**, 100, **101**
B-17F: **38-39**, 46, **53**, **57**, 58, **58**, 60-67, **61-64**, **66**, **67**, 70, 71, 73, 74, **75-76**, 76, 77, **78**, **80**, **84**, **87**, 88, **89**, **93**, 94, **94**, 96, 97, **96-98**, 99, **100**, **101**, 103
B-17G: 62-65, 67, **67**, **68**, 70-74, **71-74**, 75-77, **78**, 81, 83, **81-84**, 85, **88**, 87-92, **89-91**, **93**, 94-96, **94-101**, 99-101, 103, **103**
B-17H: 88, 86, 89, 90
B-29 Superfortress: 60, 86, 90, 96, 133
B-47 Stratojet: 144
B-52 Stratofortress: 127
B-299: 41, **41**, 42, 44
BQ-7: 87, 88, 91
C-108: 88
CB-17: 69, 88
CB-17G: **88**
DB-17: 69, 87, **87, 95**
DB-17G: 91
F-9: 89
F-10: 96
MB-17: **87**
Model 294: 41, **42**
Model 299: **40**, 41
Model 299Z: **90**, 91
Model 307 Stratoliner: 149, 152
Model 314 Clipper: 42
Monomail: 40
PB-1: **92**, 101
PB-1G: 68, 69, 86, **86**, 90, **95**, 102, **102**
PB-1R: 102
PB-1U: **87**
PB-1W: 87, **92**, **95**, 101, **101**
QB-17: 69, 87, **87**
QB-17G: 91
RB-17G: 69, **92**
RB-29: 96
SB-17: 86
SB-17G: 68-70, **68**, **86**, **88**, 90, **91**, **95**, 103, **103**
SB-29: 86
TB-17: 69
TB-17G: 71, **95**
TB-40: **65**
VB-17: 69, 88
VB-17G: **88**, **92**, **95**
XB-15: 41, 42, **42**, **44**
XB-40: 62, 63, 65, **65**, 71, 77
XB-901: 40
XC-105: 41, 44
XC-108: 86, **88**
Y1B-9A: 40
Y1B-17: **41**, 42, 44-49, **44**, **45**
Y1B-17A: **42**, 45, 48, 49
YB-9: 40
YB-17: **43**, **44**, 92
YB-40: 63, 65, **66**, 77
Boeing B-17 Colours: 68-70, **68-70**
Boeing B-17 Flying Fortress – Queen of the skies: 38-103, **38-103**
Boeing B-17 military operators: 96-103, **96-103**
Boeing/Vega XB-38: 66, **66**, 86
Boeing Vertol Chinook: 115
Boulton Paul Defiant: 85
Brazil
Air Force (Força Aérea Brasiliera): 91, 103
Brilliant, HMS: 14, 15, **15**
Bristol
138A: 148
Beaufighter: 85
Broadsword, HMS: 14, 20
Buccaneer (see Blackburn/Hawker Siddeley)
Buchon (see Hispano)
'Bull' (see Tupolev Tu-4)

C

C-47 Skytrain/Dakota (see Douglas)
C-108 (see Boeing)
C-123 Provider (see Fairchild)
C-130 Hercules (see Lockheed Martin)
Ca 313 (see Caproni)
Canada
Royal Canadian Air Force: 103
Canberra (see English Electric)
Canberra, B-57 (see Martin)
Caproni Ca 313: 28
Cardiff, HMS: 23
CB-17 (see Boeing)
CB-17G (see Boeing)
Cessna O-2 Skymaster: 114
Chinook (see Boeing Vertol)
Clipper, Model 314 (see Boeing)
Condor, Fw 200 (see Focke-Wulf)
Consolidated B-24 Liberator: 57-59, 62, 65, 67, 68, 73, 80, 82, 84, 86, 96, 98-100, 102
Convair
B-36: 144
B-58 Hustler: 147
F-102 Delta Dagger: 132, 133, 136, 143, 146, 147
F-106 Delta Dart: 147
TF-102A: **133**
Cougar, F9F (see Grumman)
Counter Invader, B-26K (see Martin)
'County'-class destroyer: 13, 14
Courier, U-10 (see Helio)
Coventry, HMS: 20
C.R.42 (see Fiat)
Curtiss
P-40 Warhawk/Kittyhawk/Tomahawk: 51, 66
XP-71: 151
XP-87 (XF-87): 133, 134

D

D.VIII *et seq* (see Fokker)
D3A 'Val' (see Aichi)
Dagger (see IAI)
Dakota, DC-3 (see Douglas)
Dassault
Mirage III: 4, 6-9, **7, 8**, 11-13, **13**, 21, 23-26, **23, 25**
Mirage IIIBJ: 26, **27**
Mirage IIICJ: 26, **26, 27**
Mirage IIIDA: 6, **11**, 26
Mirage IIIE: 6
Mirage IIIEA: **4-6**, 6, 7, 11, **13, 23, 24**
Mirage 5P: 26, **26**, **27**, **27**
Super Etendard: 12, 15
DB-1 (see Douglas)
DB-17 (see Boeing)
DB-17G (see Boeing)
DC-2 (see Douglas)
DC-3 Dakota (see Douglas)
Defiant (see Boulton Paul)
de Havilland
D.H.98 Mosquito: 85, 124, 149, 152, 154, 155, 157
D.H.100 Vampire: 34, 37
Mosquito NF.Mk XV: 149-151, **149**
de Havilland Canada DHC-6 Twin Otter: 20, **20**
Delta Dagger, F-102 (see Convair)
Delta Dart, F-106 (see Convair)
Denmark
Air Force (Kongelige Danske Flyvevabnbeni): 103
Royal Danish Air Force: 70
DF-89A *et seq* (see Northrop)
D.H.82 *et seq* (see de Havilland)
DHC-6 Twin Otter (see de Havilland Canada)
Dominican Republic
Air Force (Fuerza Aérea Dominicana): 103
Douglas
A-1 (AD) Skyraider: **106**, 108, 111, 112, 115, 117
A-1E: 110-112, **112**, 114, 115, **116**, **117**
A-4 (A4D) Skyhawk: 4, 8, 20, 23, 25
A4D-2 (A-4B): 7, 12, **13**, 14, 16, 18, 26
A4D-2N (A-4C): 4, 5, 10, 14-16, 18, 26
A-4Q: 17, 25
AC-47: 104, 105, **113**
XF3D-1: 133, 134
Draken, J 35 (see Saab)

E

Eagle, F-15 (see McDonnell Douglas)
EF-89B (see Northrop)
English Electric Canberra: 12, 23, 24, 125-127, **125, 126**
EP-1 (see Republic)
Exeter, HMS: 24

F

F3D Skyknight (see Douglas)
F-4B *et seq* Phantom II (see McDonnell Douglas)
F8F Bearcat (see Grumman)
F-9 (see Boeing)
F9F Cougar (see Grumman)
F9F Panther (see Grumman)
F-10 (see Boeing)
F-15 Eagle (see McDonnell Douglas)
F-16A/B (see Lockheed Martin)
F27 (see Fokker)
F-51 Mustang (see North American P-51)
F-61 (see Northrop P-61 Black Widow)
F-84E/G Thunderjet (see Republic)
F-84F Thunderstreak (see Republic)
F-86 Sabre (see North American)
F-86A *et seq* (see North American)
F-89 Scorpion (see Northrop)
F-89A *et seq* (see Northrop)
F-94 Starfire (see Lockheed Martin)
F-94A *et seq* (see Lockheed Martin)
F-101A *et seq* Voodoo (see McDonnell)
F-102 Delta Dagger (see Convair)
F-106 Delta Dart (see Convair)
F-111 (see Lockheed Martin)
Fairchild
C-123 Provider: 106-108, **107**, **108**, 114-116, **115**
UC-123B: **107**, **108**
UC-123K: **107**
Farm Gate mission: 104-113
Fearless, HMS: 5
FFVS J 22: 29, 31-34
Fi 103 ('V-1') (see Fieseler)
Fiat C.R.42: 29
Finger (see IAI)
Fieseler Fi 103 ('V-1'): 88
Flying Fortress, B-17 (see Boeing)
Focke-Wulf
Fw 189: 31
Fw 200 Condor: 102
Fokker
D.XXIII: 31
F27: 27
G.1: 28
Fw 156 *et seq* (see Focke-Wulf)

G

G.1 (see Fokker)
G.41 (see Gloster)
GAL.41 (see General Aircraft (Monospar))
GAL.46 (see General Aircraft (Monospar))
Gates Learjet: 21, 22
General Aircraft (Monospar)
GAL.41: 149, 152
GAL.46: 149, **149**
General Dynamics aircraft (see under Lockheed Martin)
Germany
Air Force (Luftwaffe): 52, 57, 61, 62, 64, 65, 70, 78-80, 83, 84, 86, 93, 97,148
Gladiator (see Gloster)
Glamorgan, HMS: 10, 11
Gloster
G.41: 150
Gladiator: 28, 102
Meteor: 6, 150
Gneisenau: 52
Gripen, JAS 39 (see Saab)
Grumman
F8F Bearcat: 87
F9F Cougar: 137
F9F Panther: 134, 137

H

H-21 (see Vertol)
H-34 Seabat (see Sikorsky)
Halifax (see Handley Page)
Hampden (see Handley Page)
Handley Page
Halifax: 47, 103
Hampden: 52
Victor K.Mk 1: 126
Hart (see Hawker)
Hawaii
Hawaiian Air Force: 51
Hawker Hart: 28
He 51 *et seq* (see Heinkel)
Heinkel
He 111: 49
He 219: 30
He 280: 30
Helio
U-10 Courier: 105, 106, 114, **114**, **115**
U-10B: 110
Hercules, C-130 (see Lockheed Martin)
HH-3E (see Sikorsky)
Hispano Buchon: 94
Hudson (see Lockheed Martin)
Hustler, B-58 (see Convair)

I

IAI
Dagger: 4, **4**, 5, **5**, 7-23, 25-27, **7-9**, **11**, **14**, **16**, **18**, **19**, **21**, **22**, **25**
Finger: 7, **26**, **27**
Kfir-C7: 7, 26
Nesher: 7, **7**
Invader, B-26 (see Douglas)
Israel
Air Force (IDF/AF): 70, 92, 103

J

J 21 (see Saab)
J 21A *et seq* (see Saab)
J 22 (see FFVS)
J 23 (see Saab)
J 28 (see de Havilland D.H.100 Vampire)
J 29 Tunnen (see Saab)
J 35 Draken (see Saab)
Japan
Imperial Japanese Navy: 51
JAS 39 Gripen (see Saab)
Jaspers, SS: 7
JF-89A (see Northrop)
JF-89D (see Northrop)
Ju 86P (see Junkers)
Ju 86R: 149
Ju 388J: 151

K

Kawanishi Type 97 'Mavis': 53
KC-130 (see Lockheed Martin)
Kfir-C7 (see IAI)
Ki-98 (see Nakajima)

L

L 21 (see Saab J 21)
Lancaster (see Avro)
Lansen, A 32A (see Saab)
Laos
Royal Laotian Air Force: 111, 113
Learjet (see Gates)
Liberator, B-24 (see Consolidated)
Lightning, P-38 (see Lockheed Martin)
Lincoln (see Avro)
Lockheed Martin
B-34/PV-1 Ventura: 102, 103
C-130 Hercules: 6, 9, 14, 17
F-16A/B: 6
F-94 Starfire: 130, 133
F-94C: 136, 137
F-111: 127
Hudson: 102, 103
KC-130: 12
P-2 (P2V) Neptune: 103
P-38 Lightning: 31, 36, **55**, 66, 78, 79
TF-80C: 133
U-2: 126
XC-35: 149
XP-58: 151
Lynx (see Westland)

M

Manchester (see Avro)
Marauder, B-26 (see Martin)
Martin
146: 44
B-10: 40
B-26 Marauder: 104-108, **105**, **109**, 110, 112, 113
B-26B: 110
B-26C: **109**, 110
B-26K Counter Invader: 104, **105**, **110**
B-57 Canberra: 112, 115, 116
RB-26: 104, 106, 109, **110**
'Mavis' (see Kawanishi Type 97)
MB-17G (see Boeing)

INDEX

McDonnell F-101B Voodoo: 143, 147
McDonnell Douglas
F-4E Phantom II: 6
F-15 Eagle: 129
Me 163 *et seq* (see Messerschmitt)
Messerschmitt
Bf 109: 47, 63
Bf 109J: 94
Me 262: 89, 101
Meteor (see Gloster)
MiG-15 *et seq* (see Mikoyan)
Mikoyan MiG-15: 86
Mirage III (see Dassault)
Mirage IIIA *et seq* (see Dassault)
Mirage 5P (see Dassault)
Mirage & Dagger in the Falklands: 4-27, **4-27**
Mitchell, B-25 (see North American)
Mitsubishi A6M Zero-Sen (Zeke): 51, 54, 55, 57
Model 212 (see Bell)
Model 294 (see Boeing)
Model 299 (see Boeing)
Model 299Z (see Boeing)
Model 307 Stratoliner (see Boeing)
Model 314 Clipper (see Boeing)
Monomail (see Boeing)
Mosquito, D.H.98 (see de Havilland)
Mosquito NF.Mk XV (see de Havilland)
Mustang, P-51 (F-51) (see North American)
Mustang I *et seq* (see North American)

N

N-24 (see Northrop)
N-149 Long-range Interceptor (see Northrop)
NA 14-3M (see North American)
Nakajima Ki-98: 31
Neptune, P-2 (P2V) (see Lockheed Martin)
Nesher (see IAI)
North American
AT-28: 111
B-25 Mitchell: 68
F-86 Sabre: 4, 129
F-86D: 136
F-86F: 6, 144
F-86H: 144
Mustang III: **124**
NA 14-3M: **29**
P-51 (F-51) Mustang: 79, 83, 94
P-51B: **83**
P-51C: **83**
P-51D: 32
T-6: 30
T-28 Trojan: 104-106, **104-106**, 108-114, **111-113**
T-28A: 106
T-28B: 106
T-28C: 106
T-28D: 106, **106**, 113
Northrop
DF-89A: 137
DF-89B: 137
DF-89J: 147, **147**
EF-89B: **129**, 137
F-89 Scorpion: 128-147, **128-147**
F-89A: **129**, 134-138, **136, 137**
F-89B: **129**, 130, 134-138, **137**, 140, 142
F-89C: 130, **130, 131**, 132, 135-144, **138, 139, 142**
F-89C Gun-Val: 139, **139**
F-89D: 130, **130**, 140-147, **140-143**
F-89E: 144, **144**
F-89F: 144, **144**
F-89G: 144, 145
F-89H: **132**, 143-146, **145, 146**
F-89J: 133, **133**, 143, 146, **146**, 147, **147**
JF-89A: 137, **137**
JF-89D: 143, **143**
N-24: 133
N-149 Long-range Interceptor: 147
P-61 (F-61) Black Widow: 31, 132
'Swept-wing F-89': 137, **137**
XF-89 (XP-89): **128**, 132, 134-136, **134**
XF-89A: 135
XF-89A: 135-137, **135, 136**
XF-89D: **131**, 137, 140, **140**, 142
YF-89E: 139, 144, **144**
YF-89F: 144
YF-89H: 143, 145, **145**
Northrop F-89 Scorpion – Variant briefing: 128-147, **128-147**

O

O-2 Skymaster (see Cessna)
Operation
Chastise: 118-127
Chowhound: 98-100
Crossroads: 69, 87, 91
Desert Shield: 127
Desert Storm: 127
Frantic: 78
Jural: 127
Plumb Bob: 133, 147
Ranch Hand: 106-108
Taxable: 122, 124
Torch: 62, 82
Warden: 127

P

P-2 (P2V) Neptune (see Lockheed Martin)
P-35 (see Seversky)
P-38 Lightning (see Lockheed Martin)
P-39 Airacobra (see Bell)
P-40 Warhawk/Kittyhawk/Tomahawk (see Curtiss)
P-51 (F-51) Mustang (see North American)
P-51A *et seq* (see North American)
P-61 (F-61) Black Widow (see Northrop)
Panavia Tornado IDS: 127, **127**
Panther, F9F (see Grumman)
PB-1G *et seq* (see Boeing)
Plymouth, HMS: 21, **21**, 22, **22**, 25, 26
Poland
Air Force: 28
Portugal
Air Force (Força Aérea Portuguesa): 70, 103
Provider, C-123 (see Fairchild)
PV-1 Ventura (see Lockheed Martin B-34)

Q

QB-17 (see Boeing)
QB-17G (see Boeing)

R

RB-17G (see Boeing)
RB-26 (see Martin)
RB-29 (see Boeing)
Re 2000 (see Reggiane)
Reggiane Re 2000: 28
Republic
2-PA: 28
EP-1: 28
F-84E/G Thunderjet: 137
F-84F Thunderstreak: 137
Rex, SS: 43, 47
'Rothesay'-class frigate: 14

S

Saab
A 21: **28**, 34
A 21A: 31, 36
A 21A-3: 31, **32**, 33, **33**, 34, **36**
A 21R (see 37: **34, 36, 37**
A 29B: 34, 36
A 32A Lansen: 35, 37
B 17: **29**, 30, 34
B 18: 29, **30**, 35
B 21A-3: 33
J 21: 28-37, **28-37**
J 21A: **28, 30**, 31, **32, 33**, 34-37
J 21A-1: 30-34, **30, 31**
J 21A-2: 32-34, **32**
J 21A-3: 33, 34
J 21R: 28, 32-37, **33-37**
J 21RA: 35, 36
J 21RB: 36
J 23: 29
J 29 Tunnen: 34-37, **37**
J 35 Draken: 35, 37
JAS 39 Gripen: 32, 35, 37
Viggen: 36, 37
Saab J 21 – Sweden's ingenious fighter: 28-37, **28-37**
Sabre, F-86 (see North American)
Savoia-Marchetti S.M.91: 31
SB-17 (see Boeing)
SB-17G (see Boeing)
SB-29 (see Boeing)
SC-47 (see Douglas)
Scorpion, F-89 (see Northrop)
Seabat, H-34 (see Sikorsky)
Sea Harrier (see BAe)
Sea King (see Westland)
Seversky P-35: 28
Sheffield, HMS: 12
Short Stirling: 47
Sikorsky
H-34 Seabat: 111
HH-3E: **117**
Sir Bedivere, RFA: 19, **19**
Skyknight, F3D (see Douglas)
Skymaster, O-2 (see Cessna)
Skyraider, A-1 (AD) (see Douglas)
Skytrain/Dakota, C-47 (see Douglas)
S.M.91 (see Savoia-Marchetti)
Spain
Air Force (Ejercito del Aire): 27
Spitfire (see Supermarine)
Spitfire Mk I *et seq* (see Supermarine)
Starfire, F-94 (see Lockheed Martin)
Stirling (see Short)
Stratofortress, B-52 (see Boeing)
Stratojet, B-47 (see Boeing)
Stratoliner, Model 307 (see Boeing)
Sud-Est Vautour: 147
Super Etendard (see Dassault)
Superfortress, B-29 (see Boeing)
Supermarine
Spitfire: 150, 152, 154-156
Spitfire Mk VI: 152
Spitfire Mk VII: 152
Sweden
Aeronautical Research Establishment: 29
Air Board (KFF): 29
Air Force (Svenska Flygvapnet): 28, 29, 32-35
Army: 29
Navy: 29, 33
Royal Institute of Technology: 29
'Swept-wing F-89' (see Northrop)

T

T-6 (see North American)
T-28 Trojan (see North American)
T-28A *et seq* (see North American)
TB-17 (see Boeing)
TB-17G (see Boeing)
TB-40 (see Boeing)
TF-80C (see Lockheed Martin)
TF-102A (see Convair)
Thailand
Royal Thai Air Force: 111
Thunderjet, F-84E/G (see Republic)
Thunderstreak, F-84F (see Republic)
Tirpitz: **122**, 123, 124, 127
Tornado ADV/ECR/IDS (see Panavia)
Trojan, T-28 (see North American)
Tu-2 *et seq* (see Tupolev)
Tunnen, J 29 (see Saab)
Tupolev Tu-4 'Bull': 128, 133
Twin Otter, DHC-6 (see de Havilland Canada)
Type 97 'Mavis' (see Kawanishi)
Type 279 Venom (see Vickers)
Type 432 (see Vickers)

U

U-2 (see Lockheed Martin)
U-10 Courier (see Helio)
UC-123B *et seq* (see Fairchild)
UH-1A *et seq* (see Bell)
United Kingdom
Air Ministry: 148, 149
British Army: 13
Special Air Service (SAS): 13
Royal Aircraft Establishment
Aeroplane & Armament Experimental Establishment (A&AEE): 84, 85, 103, 152, 154
Farnborough: 103, 152, 154
Royal Air Force: 7, 12, 25, 39, 46-49, 52, 53, 60, 61, 64, 65, 70, 73, 74, 76, 84, 85, 94, 102, 103, 118-127
Commands
Bomber: 48, 52, 64, 85, 102, 118, 120, 121, 123, 125, 126
Coastal: 47, 48, 60, 61, 64, 70, 84, 102, 103
Strike: 126, 127
Photographic Reconnaissance Unit (PRU): 154
Royal Navy: 4, 7, 9, 11-14, 18, 27, 126
Fleet Air Arm: 10
United Nations: 127
United States
Air Force: 6, 68, 69, 86-88, 96, 102, 104-117, 125, 127-129, 133-140, 142-147
Air Force Museum: 88, 91, 93, 103, 107
Air Forces
13th: 107
Far East (FEAF): 128
Pacific (PACAF): 104
Air National Guard: 128-129, 133, 137, 139, 143, 146, 147
Center
Flight Test: 138
Commands
Air Defense: 128, 132, 133, 137, 139, 141-143
Alaskan Air: 86, 139, 141-143, 146
Northeast Air: 130, 141-143
Strategic Air: 127
Tactical Air: 104, 105, 114
Service
Military Air Transport: 130
Army: 40, 104, 110, 143, 147
Special Forces ('Green Beret'): 104
Army Air Corps (USAAC): 40-51, 53
Army Air Force (USAAF): 47, 51-54, 56-58, 60-62, 65-68, 70, 71, 85, 88-91, 93, 96, 103, 132, 133
Air Forces
1st: 101
2nd: 101
3rd: 101
4th: 101
5th: 96
6th: 101
7th: 96
8th: 58-63, 65-68, 71-73, 78-80, 82-84, 86, 89, 93, 95-100, 123
9th: 100
10th: 62, 96
12th: 62, 63, 82, 100
13th: 96
15th: 66, 67, 78, 84, 86, 100, 101
Caribbean: 101
North African Strategic: 62
Panama: 101
Commands
Bomber: 60
Mediterranean Air: 62
Transport: 97
Central Intelligence Agency: 69, 92, 95, 111
Coast Guard: 69, 86, 90, 102
Forest Service: 69, 91
Iceland Defence Force: 130
Marine Corps: 127, 134
Navy: 47-49, 69, 87, 88, 92, 96, 101, 102, 106, 112, 127, 134, 143
Unit Heritage
The Dambusters – No. 617 Squadron, RAF: 118-127, **118-127**

V

'V-1' (see Fieseler Fi 103)
'Val' (see Aichi D3A)
Valiant (see Vickers)
Vampire, D.H.100 (see de Havilland)
Vanguard (see Vultee)
Vautour (see Sud-Est)
VB-17 (see Boeing)
VB-17G (see Boeing)
Venom, Type 279 (see Vickers)
Ventura, B-34/PV-1 (see Lockheed Martin)
Vertol H-21: **110**
Vickers
Type 279 Venom: 154
Type 432: 148-151, **148**, 154-157, **156, 157**
Valiant: 126
Warwick: 154
Wellesley: 154
Wellington: 52, 85, 149, 150, 156
Wellington Mk V: 149, 154
Wellington Mk VI: 149, **149**, 150, 154, 156
Windsor: 154, 157
Vickers-Armstrong aircraft (see Vickers)
Victor K.Mk 1 (see Handley Page)
Viet Cong: 105, 106, 108, 110, 111, 113-117
Vietnam (North)
North Vietnamese Army (NVA): 111, 115, 116
Vietnam Republic
Air Force (VNAF): 106, 108, 110
Army (ARVN): 104-106
Marines: 110
Viggen (see Saab)
Voodoo, F-101 (see McDonnell)
Vulcan (see Avro)
Vultee
Vanguard: 28
XP-54: 31

W

Warhawk/Kittyhawk/Tomahawk, P-40 (see Curtiss)
Warwick (see Vickers)
Wellesley (see Vickers)
Welkin and Type 432: 148-157, **148-157**
Wellesley (see Vickers)
Wellington (see Vickers)
Wellington Mk V (see Vickers)
Wellington Mk VI (see Vickers)
Westland
Lynx: 15, 23
Sea King: 23
Welkin: 148, **148**, 149, **150**, 151-154, **151-155**, 156, 157, **157**
Whirlwind: 151
Whirlwind (see Westland)
Windsor (see Vickers)

X

XB-15 (see Boeing)
XB-38 (see Boeing-Vega)
XB-40 (see Boeing)
XB-901 (see Boeing)
XC-105 (see Boeing)
XC-108 (see Boeing)
XC-135 (see Lockheed Martin)
XF3D-1 (see Douglas)
XF-87 (see Curtiss XP-87)
XF-89 (see Northrop)
XF-89A (see Northrop)
XP-54 (see Vultee)
XP-58 (see Lockheed Martin)
XP-71 (see Curtiss)
XP-87 (see Curtiss)
XP-89 (see Northrop XF-89)

Y

Y1B-9A (see Boeing)
Y1B-17 (see Boeing)
Y1B-17A (see Boeing)
YB-9 (see Boeing)
YB-17 (see Boeing)
YF-89A *et seq* (see Northrop)

Z

'Zeke' (see Mitsubishi A6M Zero-Sen)

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Larry Davis Collection. **43:** Aerospace (three) **44:** Aerospace (two), Larry Davis Collection. **45:** Larry Davis Collection, Aerospace. **46:** Aerospace (two), Douglas via Harry Gann. **47:** Aerospace (three), IWM. **48:** Larry Davis Collection (two), via Andrew Thomas, Aerospace. **50:** Aerospace (three), Douglas via Harry Gann. **51:** USAF (three). **52:** Boeing, Aerospace (three). **53:** US Navy, USAF, Aerospace, Harry Gann Collection. **54:** via William N. Hess, USAF via Larry Davis, US Navy. **55:** USAF (three). **56:** Larry Davis Collection, Aerospace (two). **57:** USAF via Larry Davis, USAF (two). **58:** USAF, Lockheed, USAF via Larry Davis. **59:** USAF (two), IWM. **60:** Larry Davis Collection, USAF via Larry Davis, Aerospace (two), USAF, Boeing. **61:** USAF, Bundesarchiv via John Weal, via Harry Gann. **62:** USAF via William N. Hess (two), Larry Davis Collection, USAF (two). **63:** USAF (two), IWM. **64:** USAF, Larry Davis Collection (three), Boeing. **65:** Aerospace (four), USAF via Larry Davis. **66:** via Enzo Maio (two), Aerospace, via Warren M. Bodie. **67:** Boeing, Douglas via Harry Gann, via Harry Gann. **75:** Aerospace (two). **76:** Aerospace (five), USAF (two). **77:** Aerospace (eight), Jim Winchester, Harry Gann Collection, Larry Davis, USAF (two). **78:** USAF, Bundesarchiv via John Weal, IWM. **79:** Lockheed, Aerospace (two), via Harry Gann. **80:** Bundesarchiv via John Weal, Larry Davis Collection (two), Aerospace, USAF (three). **82:** Larry Davis Collection (seven), Aerospace, IWM. **83:** USAF via Larry Davis, USAF. **84:** Aerospace (four), IWM, USAF. **86:** USAF Museum via Larry Davis, USAF via Larry Davis, via David F. 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CONTENTS

Mirage and Dagger in the Falklands

Saab J 21

Boeing B-17 Flying Fortress

Air Commandos in Vietnam

No. 617 Squadron

Northrop F-89 Variants

Welkin and Type 432

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